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EDITORIAL NOTES.

Common Aims and Mutual Dependence.

IF Professor Schuster had searched the whole realms of science and general human affairs, he could not have discovered a subject more apposite to the times than the one he chose for his Presidential Address last Tuesday to the British Association. Superficiality has greater prevalence than profound thinking; and superficiality breeds wrong conceptions, and supplies vast ground for the existence of false beliefs. Professor Schuster has performed the good service of helping to arrest the progress of those ideas that individualize rather than unify the interests of life. It would be better if we all realized that our affairs have not that distinctiveness and isolation with which we sometimes mistakenly try to invest them. In this, and in becoming obsessed by the importance of one's own domain in life, there is the danger of losing the sense of mutual dependence. Before the war, it is to be feared, superficiality had allowed the danger to assume the form of a real fact, with constantly swelling proportions. "But in the shadow of a "great catastrophe, it has been brought home to us that the "clash of interests is superficial; and the slender thread of "union which remained has grown into a solid bond." Now under the surface one sees a unity of purpose and sentiment among the heterogeneous elements into which the community was outwardly divided.

Such thoughts as these open the mind to contemplating the immensity of the error which draws lines of demarcation between the common interests and affairs of life. To fully appreciate the error, vague generalities must be dismissed, and deeper thought be brought to bear. We get, for example, sharp divisions made by the unthinking between science and business and between theory and practice; while, as a matter of fact, such divisions do not actually exist. They are mutually related; the one cannot do without the other. As Professor Schuster says, we get one man calling for the conduct of affairs on business lines; while another clamours for scientific methods. They either want the same thing or they talk nonsense. What are business lines? "Business lines" are not those haphazard rule-of-thumb methods that may or may not end satisfactorily. They are the lines that are adopted with the definite view of attaining correct results; and "every method," our presidential philosopher points out, "that leads to correct results "must be called a scientific method." It is quite possible to discount reasoning of this kind by calling to the aid extremes in contrast. That, however, is the old artifice of those who know their case is weak, or who are too obstinate to admit that superficiality and not depth of thought is the characteristic of their convictions. Those who senselessly pooh-pooh the companionship of science and business, separating them as things that have no affinity, and are incapable of synthetic treatment to the attaining of correct ends, have little, or rather no, conception of the doctrine of mutual dependence which rules here as in the other affairs of life. The same with theory and practice. It is a fatal distinction, says the President, which puts men of theory in opposition to men of practice; the obvious truth being that nothing of value is ever done which does not involve both theory and practice. They only come into opposition when one or other of them is at fault.

The vast organism which represents the life and interests of a nation is something of a very complex nature; but there is mutual dependence between every part. Every part too —every institution, every factory, every business establishment—is in itself a complicated organism. But all the separate organisms have an interdependence. Professor Schuster urges us to make the best use of this common condition, and apply to the work all the ability the country possesses. We are a nation that has acquired, and has maintained, a great empire; we have immense wealth; we conduct a vast trade in all parts of the world; we have a Navy of a power envied by our enemies; we have raised a new and immense Army in a few months, and have equipped it for the field. No one can say that Great Britain has not ability, organizing power, resource. It is not defective in any way in these as possessions. But where we have failed, and proved a deficiency, has been in bringing those possessions under proper discipline, and in exercising them nationally. The work that has had to be done in connection with the war—the formation of the Munitions Department, the passing of the National Registration Act, the formation of the Coalition Government, the establishment of British Dyes, Limited, the passing of certain coal-regulating legislation—points the accusing finger to neglect in making proper use in all directions of our resources and organizing power. All the Committees established by the Government simply mean the introduction of the, in relation to the country's affairs, new factor—discipline, and raising the much ignored common interdependence on to the higher and more prominent plane of acknowledged fact. We do not, however, want the cast-iron discipline as moulded by Germany; we want something with a little more freedom about it than that. Where liberty of movement is completely eliminated, there exist limitations to advances to the best effects. Even discipline requires to be tempered by an amount of latitude.

Professor Schuster has placed his finger on the weak spots in this country's methods—the want of a complete recognition of the common dependence of interests and affairs, and the past indifference to the utmost use being made of a great organizing ability. He occupied a platform from which he could direct general attention to these things; and we hope, despite the war, and the diversion of attention from normal affairs by air raids, that his message and advice will prove efficacious in the promotion of the end he and all with the welfare of the country at heart have in view.

The Chemist and Fuel Economy.

CALLED at short notice to the chair of Section "B" (Chemistry) of the British Association, Professor W. A. Bone, D.Sc., F.R.S., gave an address which had a double purpose. The first was to present a critical review of modern work in relation to flame and combustion; and the second, to arraign the Government, industries, and chemists for the prevalent terrible prodigality in connection with fuel consumption, and to urge that there should be systematic supervision under a central organization begotten and authorized by the Government. The review of the work latterly done in regard to the phenomena accompanying the ignition temperatures of simple and complex gaseous mixtures, as well as those relating to gaseous explosions and kindred subjects, was made in the skilful manner of which alone a master and constant student of such subjects is really capable. We have published the review in order that there may be on record an authentic digest of the present state of knowledge on these questions. Incidentally, it is remarked that among the schemes of work which Professor Bone has mapped-out for the new department over which he has control at the Imperial College of Science, is still included the one (noticed at the time that we described the new laboratories and their excellent equipment) from which he hopes to derive data as to the speed of flame propagation through mixtures of various combustible gases—not only at ordinary temperatures and pressures, but also when the mixtures are heated and used at higher pressures; and to ascertain whether, in the case of complex mixtures of combustible gases and air (coal gas and air, for example), the velocity of flame propagation can be calculated from the known velocities for its single components. Such information would be of considerable practical value in connection with the development of apparatus for burning explosive mixtures of gas and air. But the research will need much organization and expert direction, and money will be required for it. Hence the appeal of

Professor Bone, which awaits response: "Who will help us "with the necessary funds?"

Important though all the constituent subjects of the review are to progress, immediate interest and value lie in the great economic question that Professor Bone raises in connection with fuel consumption. Statistics have been liberally provided as to the available quantity of our native stores of coal; and we may either accept or reject them at will. Whichever we do will not have the slightest effect. The fact remains there is a limit to the stores; and we have no right to rob those who will come after us by prodigality in these times. We know approximately the present annual rate of the consumption of coal in the country; but Professor Bone asks in effect, if not in words, is this rate of consumption necessary in relation to the work done? His reply is that it is not. In various industries he sees immense waste going on, both in fuel and in the valuable constituents of that fuel—a waste which he drives home by telling us point-blank that it would not be, and is not, tolerated in Germany. It is not pleasant to be told that the arch enemy does things better than we do them in this country; but the truth of it should impel to better conditions here. However, the blame for the existing waste in industry is well distributed in the address. The manufacturers and those who control industries (Professor Bone paid a compliment to the gas industry for what it has done in obtaining good value from the coal it carbonizes) are at fault; but the whip was also applied freely to the shoulders of chemists and scientists who have so largely neglected the question, and have so commonly ignored the considerable area provided for research by the carbonization of coal and the resultant products. The work that has been done has been left in the hands of the few; and yet here is a fundamental field upon which much of the superstructure of chemistry stands. Engineers have wrestled with, and made the best use of, their conditions, while chemists have mainly stood aloof, when they might have intervened in a manner which would assuredly have meant greater economy, progress, and profit. The time is now especially opportune for the chemists to make amends, and bring their influence to bear on the waste of fuel and other valuables when the country has at length awakened to the fact that, by chemical agency and supervision, Germany was succeeding well in its initial efforts to depose Great Britain from its industrial and commercial supremacy. The domestic waste of fuel was also mentioned by Professor Bone; but the industrial waste is the more amenable to supervision and control.

For example of waste, Professor Bone went direct to the coke-oven industry; and much of what he had to say in this connection cannot be disputed, though it will hardly be palatable to those who own, and those who have the responsible charge of, coke-oven plants. He urges the need of better and more systematic control of bye-product plants; and we fear there is much truth in what he says that, in far too many cases, the training and the subordinate position of the chemists employed in association with such plants are not what they ought to be in what is fundamentally a chemical industry. "I can say, from personal knowledge," remarked Professor Bone, "that plants which are managed and controlled "by experienced chemists of broad training, combined with "force of character, yield much better results than those "controlled by men without such qualifications." Apart from economic considerations, lack of efficient control has strong reflection in the comparatively little use that has been made of the University Departments of Applied Chemistry which specialize in fuel. While there is this impeachment of the working of a large part of bye-product coke-ovens, the waste of beehive coke plants is infinitely worse. In these is carbonized about one-third of the 20 million tons of coal coked per annum in this country (apart, of course, from the equal quantity or thereabouts used by the gas industry); and this one-third part represents a considerable waste of valuable constituents of the coal. Here comes in Professor Bone's first recommendation, which is that public interest would justify the Government in fixing by law a reasonable time-limit beyond which no beehive coke-oven installations should be allowed to remain in operation, except by the express sanction of the State, and then only on proof of special circumstances.

It passes strange, with such a palpable waste of fuel in industry, that no organized body of scientific men thinks it is worth while to take an active interest in trying to bring about its suppression. In extenuation, however, it may be said that scientific men more generally concentrate attention upon the investigation of a single detail of a subject than on a broad economic question such as that which Professor Bone raises in his address. Probably the reason for this is that these men are not brought into contact with the actual work of industry the same as a man of science like Professor Bone, whose research work in relation to fuel has been peculiarly interlinked with industrial operations. Perhaps, therefore, something may be advanced in palliation of the neglect of others. The line of action is for one in their critic's position to stimulate interest, so as to obtain from them a following, and to press forward with their aid to the goal in view. If this goal can be attained, an inestimable national service will have been accomplished. Fuel economy means national economy. So this is a national question; and the Government ought to be fully aroused to its importance by the deliberately used words: "It is "tolerably certain that, with an efficient system of public "supervision of fuel consumption, we ought to be able, even "with existing appliances, to save many millions of tons of "our annual coal bill, and with improved appliances still "more millions—a saving which would in the long run "redeem a considerable amount of the War Loan, which "has been much more easily raised than it will be repaid." There is something here for rumination and action by our statesmen and economists, who babble about small domestic economies when a huge economy is to be effected by war on the immense waste of fuel that is proceeding daily. Only the Government can make any effective move in this matter. And the capital recommendation in the address is that the Government should be memorialized with a view to the establishment of a central organization for supervising fuel consumption and the utilization of coal somewhat on the lines of the existing alkali works inspection, which has been so beneficial to the chemical industry. Furthermore, it is suggested that, in connection with such an organization, there might be undertaken a much-needed chemical survey of British coal-fields, as well as experimental trial of new inventions for the promotion of fuel economies. The idea is good; but even good ideas fall to the ground unless persistently upheld by protagonists who are not discouraged by slow progress—such as Sir George Livesey with the co-partnership system. We hope that the address by Professor Bone is not the first and the last we shall hear of a movement for systematically effecting a national economy from fuel waste. Opponents may be found in those with coal for sale; and manufacturers are difficult people to shift from custom. If economy will not sufficiently appeal to them, there should be other ways and means of compelling the application of efficiency in the expenditure of fuel.

Calorific Power and Benzol.

THE Government have commandeered the whole of the benzol production of the country; and those motor-car owners who have been using benzol, and have experienced the excellent mileage results per gallon, are extremely sorry for themselves that supplies are denied them, though not complaining in view of the purpose to which for the time the material is being put in the national service. We have had inquiries from dealers asking whether there are any producers who are free to supply their needs, but there is only the one answer. However, the fact is the country is not getting all the benzol that is possible; and the position and demand to-day make it more reasonable than ever to point out to the Government that, if they would only do as Canada has done (as shown last week), make calorific power the universal standard for gas, instead of waiting for the change to be made as gas undertakings come to Parliament (which will mean leisurely change proceeding over a score or more of years), the gas undertakings could well increase the output of benzol, and this without inflicting any great hardship on the consumers. Of course, we should hear again of the flat-flame burner user, who some gas engineers defend as though he was one of their own progeny, instead of an obstructionist in the path of progress and the greater utilization of the resources of the gas industry. Naturally, the removal of a larger quantity of benzol from the gas than is done at the present time would result in a small percentage injury to the calorific value of the gas; but the percentage is so relatively small that it would not be appreciable to the consumers.

Wherever we look there comes corroboration of this. Early in 1913, Mr. W. J. A. Butterfield pointed out that, while the luminosity of the gas would suffer to a larger extent, the calorific value would only be depreciated by between

5 and 6 per cent. And now Mr. W. R. Herring (who is of opinion that to-day the question of benzol extraction from gas should be faced as a national, and not as purely a commercial, one), in an article in other columns, gives us the results of washing gas by unbenzolized wash-oil and prebenzolized wash-oil. With the former 16·11-candle gas ("Metropolitan" burner) was reduced to 10·51 candles—a loss of 34·7 per cent. of luminous value. But the gross calorific value, 585·3 B.Th.U., only suffered a 4·5 per cent. depreciation, or to 559·1 B.Th.U. With the prebenzolized wash-oil (with 5 per cent. of benzol added), the illuminating power was only reduced from 16·08 to 15·06 candles, or about 6·34 per cent., while the calorific value was reduced from 579·4 to 576 B.Th.U.—a loss of 0·58 per cent. The figures, however, which are important at the present time are those obtained when using unbenzolized oil; and, as Mr. Herring points out, the comparatively insignificant loss of calorific value when using such wash-oil must forcibly strike all gas engineers. The experiments go to prove that a large proportion of the benzol can be removed from gas, and still leave a candle value sufficient to give some luminous effect when burned as a naked flame, while only depreciating the calorific value by the small amount shown. Upon these results, Mr. Herring suggests that it is in the hands of the Government to enable the gas industry to be of even greater public and national service than it is to-day, and accomplishment is through the universal application of a reasonable calorific value standard, and freeing the industry from the incidence of the luminous flame test.

The war is producing a vast amount of change in the methods of the country and of its industries; and some of this change is going to be permanent. There is not the slightest reason why the change should not include the universal application of a reasonable calorific value standard, so as to put gas undertakings in the position to better serve the country.

Difficulties of Standardizing Illumination.

DURING the past week, there has been more time available than previously to examine the report of the Home Office Departmental Committee on Lighting in Factories and Workshops; and now, although this is only the first report, it may be asked, upon the strength of the information contained in it, whether there is any prospect of the Committee being able in the final result to prescribe exact standards of illumination for factories and workshops, under the incalculable variety of work, eyesight, and environment to be found in such places? On the showing of the report, it is pretty safe to say that the time is far distant when anything of the kind will be accomplished; and it may be doubted whether such a consummation will ever crown the work in hand. All that now seems possible is for the Committee to generalize; and generalization can only be directive and not definitive in its application. While saying this, we are not suggesting that there is no value in the work the Committee have been carrying on, and in the large accumulation of information presented to those concerned. It is all to the good that this should have been brought together, because we know it to be a fact that there are many factories very imperfectly illuminated, and that this condition of things contributes to accidents, is harmful to vision, and cannot be conducive to the best outputs, quantitatively and qualitatively. If the work of the Committee produces improvements without absolute standardization, good will have been achieved.

The report is practically a confession on the part of the Committee as to the impossibility of getting beyond a state of generalization in the matter of prescription. The Committee themselves declare that they only feel justified in recommending that requirements in general terms for adequate and suitable lighting should be applied to all factories and workshops; and later on they show the limitations which they have come up against by saying that "lighting "requirements vary so much that each trade, or even each "process, must be considered on its merits, and a standard "of anything like general application is possible in well-"defined circumstances only." The complex conditions which the Committee find blocking the way to giving a complete finish to their work have evidently been experienced by other countries, some of which seriously took up the matter of the better lighting of factories and workshops long before we did at home. But though it is not a new subject with them, they have got no further than the prescription of "adequate lighting," which is a term that is beautifully elastic, and rightly so; for lighting which is "adequate" wobbles about in degree according to the conditions of occupation. The countries in mind are Austria, Belgium, Denmark, France, Germany, Holland, Italy, Norway, Sweden, and most of the United States. Only in Holland has an attempt been made to define values as minimum standards of illumination; and these merely apply to fine work. But it further attests the great difficulties of the matter when it is learned that even these standards for fine work have recently been doubled, which does not say much for the first attempts at prescription. In Belgium there is also prescription against excessive glare. In the Indian Factory Act of 1911, the Inspectors have power to require "adequate" illumination; and a definite standard for general lighting in factories is in force in New South Wales. There we stop in the matter of precedent; and beyond the possible adoption some day of compulsory "adequate" lighting for factories and workrooms in this country (probably with penalties for default), we doubt very much whether we shall ever go. At any rate, the report does not encourage hope.

What is "adequate" lighting? The Committee are not in a position to define it; and the attempt they have made at some sort of explanation is loose and uncertain. That the Committee feel that this is a characteristic of their recommendations is shown by their admission that they are fully aware that, until it is possible to define standards, difficulties may arise from time to time in the enforcement of the requirement. However, adequate lighting, they say, should include: (1) A "reasonable" degree of constancy and uniformity of illumination over the necessary area of work; (2) the placing and shading of lamps should be effected so that the light from them does not fall directly on to the eyes of the operator when engaged on his work, or when looking horizontally across the workroom; (3) the disposition of lights should be in such manner as to avoid the casting of extraneous shadows on the work. The loopholes here for dissension between inspectors and factory owners are plentifully provided, not through any lack of competence on the part of the Committee, except that none of the members, so far as we are aware, have any practical experience as factory owners, as managers of factories, or as workers in them. Their inability to arrive at something more definite is due to conditions so complex as to be unamenable to a common law. For general illumination, the Committee do venture upon a prescription, which they recommend for adoption. Over the working area of workrooms, they suggest that the illumination, measured on a horizontal plane at floor-level, shall be not less than 0·25 foot-candle, without prejudice to the illumination required for the work itself. "Without "prejudice" is a term in this connection that is a bit ambiguous. We take it this 0·25 foot-candle is intended to be the minimum, independent of the local lighting required for the work itself, and which local lighting is not always uniformly in existence. But the local lights when in use would fortunately supplement the general illumination—"fortunately," for in places where there is moving machinery and ground surface pitfalls the 0·25 foot-candle rather errs on the wrong side. Then in all parts of iron foundries where work is carried on, or over which any person is ordinarily liable to pass, the illumination, similarly measured, it is proposed shall not be less than 0·4 foot-candle. In all other parts of factories, the suggested illumination is not less than 0·1 foot-candle; and in open spaces not less than 0·05 foot-candle, which is absurd as a general prescription. In some of the open spaces of factories of which we know, there are railway lines, awkward points and curves, and shunting equipment; also spirited little locomotives (sometimes full-sized ones) and railway waggons moving about at all hours of the night. There are underground hoppers for the reception of coal and other material, to fall into which has unsatisfactory results; and there are numerous other obstructions and traps for wayward feet. Yet the Committee would be satisfied with the illumination of these open spaces if not less than 0·05 foot-candle!

In order to make investigation as to the quantity of local light required for various operations, experiments have been instituted at the National Physical Laboratory; but the fact that the research has not yet got further than seamstresses and tailors shows that the Committee have something in hand in regard to which it will be a miracle if they can ever claim to have reached perfection. Differences in condition of work and eyesight, character and colour of work, impose obstacles to the specifying of any exact illumination. What

is clear is that each worker should be provided with a light with a good range which he himself can regulate according to the nature of the work on which he is engaged, and to suit his own eyesight. The Committee have not included this provision in their general recommendations; and yet obviously it is the most sensible thing that could be done, instead of saying to a man: "The light you require is 1·25 "foot-candle for that work, or 4, 5, or 6 foot-candles for "that work." The man would not perhaps express in words what he thought. However, in tests at the National Physical Laboratory, the conditions were not factory or workroom ones; and the number of investigations that could be carried out under such conditions is limited, as well as is the value. The conditions, for instance, would not apply to factories or workrooms in which there is moving machinery, and vibrations result; and the beautiful atmospheric circumstances of Bushey are not what are found in the most populous parts of the land where seamstresses, tailors, and other people are employed. Electric metal filament lamps were used in the experiments—variously, with direct lighting with opal shades to the lamps, indirect lighting, and shielded lighting with the lamps enclosed in aluminium shades of parabolic form. Electric lighting was adopted, it is stated, on account of the ease with which regulation can be effected for experimental laboratory purposes—in other words, by inserting resistances any degree of illumination could be secured up to a maximum of 12 foot-candles. It seems to have been overlooked that a gas-tap is an excellent means of regulating light. Anyway, the experiments prove the impossibility of specifying any one standard of illumination. The persons who acted as the mediums for the investigators, under strange conditions, came to the conclusion that 1¼ foot-candles were sufficient for white material; and though they stated that 4 foot-candles were ample for black material, they thought that, for comfortable operation, 5½ foot-candles would be better. Shades between these extremes in colour required other quantities. This being so, workpeople having different eyesight, and factory and workroom conditions being different, it points to an adjustable system of lighting being the best. One other point is that the figures provided by the Bushey experiments are not those that would be required for local lighting in a factory where a good general system of illumination prevailed, which apparently was not the case in the test-rooms. That is a distinct factor to be taken into consideration in workshop and factory lighting.

One thing the experiments do, and that is to sound the death-knell of indirect lighting for most workroom occupations. The seamstresses and tailors all preferred direct lighting with shades, so as to keep their eyes free from glare. In every case the indirect lighting was condemned as inadequate, and the illumination had to be increased—in one case by 100 per cent., in others by 40 per cent. In distinguishing detail, too, a considerably greater illumination was required than with direct lighting. Under such circumstances, indirect lighting will not be readily accepted as an economical and useful lighting agent; for factory owners do not want to use 40 to 100 per cent. more current than is necessary for adequacy, nor do they want to incur the concomitant expenses of the system and of the increased number or larger unit lamps requisite. On these points, the tests at the National Physical Laboratory are confirmative of what was already known, and what would suggest itself to any intelligent person who set himself to consider the relations of illumination to work of varied kind, and executed by people with dissimilar vision in different circumstances. On many other points, the work at the laboratory is certainly educative.

However the deeper one penetrates into the report, more and more magnified become the difficulties that face the Committee in trying to make rational illumination prescriptions for a mass of contrary conditions.

Public Retrenchment and University Efficiency.

Economy is in the air; and the Government have appointed a Committee on Public Retrenchment. One result of the work of the latter will be that those people who are interested in, and who may be adversely affected by, their recommendations will think the Committee very foolish and incompetent; while those who are interested but are left undisturbed will find no cause, under the circumstances, to quarrel with the Committee's proposals. But there is one direction in which all intelligent men will agree that it would be wrong, and inimical to national interests, to start economizing, and that is in connection with the work that is now being performed by our new universities—for example, Manchester, Liverpool, Leeds, and Sheffield. To reduce expenditure, and to call it "economy" when it tends to the diminution of efficiency, is a gross misapplication of the term. As a nation, we cannot afford to have the efficiency of the newer universities reduced; on the contrary, the higher the efficiency, the greater the national result. Their income is already small enough, and ridiculously so in the way of annual subsidies from the Government, when placed in comparison with the grants provided from the public purses in Germany and the United States.

In order that the Committee on Public Retrenchment shall have the facts before them, and know exactly the strength of the claims to considerate treatment, the Vice-Chancellors of the four Northern Universities named have addressed a communication with this object to the Joint Secretaries of the Committee; and we cannot imagine anyone who will give studious thought to what is said in the communication doing other than concluding that the Committee would be performing a national disservice if, in their quest for lines of retrenchment, they recommended a reduction of the grants allowed to universities which are now accomplishing such grand work for the country. It is indeed work of the utmost economic value, seeing that its main purpose is the provision of men equipped with the means for helping in the advancement of industrial and commercial efficiency. Never before, as the Vice-Chancellors truly say, have we felt so much as at the present time the indispensability of such work; and it is vital to the future economic strength of the country. What the German Technical High Schools have done for German industry, the newer English universities have done, and are doing, for British trade. We must admit that the claims of these universities are indisputable. Their sources of income are grants from the Government and local authorities and the fees of students. If, unfortunately, the Government lowered their grants, the local authorities would be almost sure to follow suit. Besides now and after the war, the universities, through the certain falling-off of fees, will be in "reduced circumstances;" and yet, it is very generally acknowledged, this is more especially a period when there is room in this country for the promotion of higher industrial efficiency through the employment of men trained in the science as well as the practice of those things which are the sources of the wealth and sustenance of the nation. The Vice-Chancellors are justified in asking the Committee on Public Retrenchment to consider carefuly their submissions, and to defend the Universities against any suggestion which would work ill upon, instead of advantage, the country.

Gas Supply in Melbourne.

An increase of 8½ per cent. in the sales of gas for the first half of the present year, as compared with the corresponding period of 1914, forms the best possible indication of the satisfactory condition of the business of the Melbourne Metropolitan Gas Company, whose half-yearly meeting is reported in the news columns of this issue. How rapid the progress made has been is further shown by a remark of the Chairman, that the output of gas for the past six months equalled approximately the total output for the year 1907. The number of consumers is, of course, increasing; but it is evident much of the larger demand arises from the additional purposes for which gas is being consumed, owing to the policy pursued by the Company in the direction of pushing the installation of gas heating and cooking apparatus. The value, too, of the satisfied consumer is shown by the statement at the meeting that a large proportion of the business in fires has been derived from consumers who, previously having experience with one fire, had decided to extend the use of these labour-saving appliances in their homes. Much is also being done in the way of extending the consumption of gas for industrial purposes; while the work of the Company in connection with high-pressure gas lighting has on previous occasions been brought to the notice of readers. Altogether, the record of work placed before the proprietors was an excellent one. There is another matter upon which those connected with the undertaking deserve congratulation—namely, the number of employees on active service. It is a fact to be proud of that nearly 200 of the employees of the Company should have offered themselves for service in defence of their country.

Preparing the Way.

The Sulphate of Ammonia Association were indicating just recently that, at all events in one country of which they knew, the German makers had agents busy preparing the way for, directly peace was declared, recapturing trade abroad. Confirmation of the Germans being active overseas to keep their foreign markets warm is given in an article in "Eastern Engineering," which is based on information supplied by a New York correspondent. Directly the war is over, the Germans will require to become possessed of a large quantity of raw material which they have to import, but, through certain obstacles, cannot just now. The correspondent in question names 200 millions sterling as the sum that will have to be promptly spent in this way. But the money will have to be forthcoming. Germany is therefore putting itself into a position to establish a sort of *contra* account with the countries from which it will want to draw raw materials. This being so, the informant asserts, it is, during the war, maintaining as far as possible the manufacture of iron and steel, and storing up the products. The production of potash is also being continued on the large scale; and the dye factories are running at full speed. Directly the war is over, these and other accumulations of productions will be placed in the most receptive markets, and cash payments be demanded, so that stocks of the requisite raw materials may be purchased. Gold will be wanted; for the reputation that Germany's want of good faith with other countries, and its diabolical and murderous acts on defenceless people, has established is such that nobody will have any credit to spare for it. The American markets, it is said, are swarming with German agents. Users of steel are being asked for lists and specifications of the sheets and tubes they employ; and wily agents who are paving the way for a prompt resumption of trading by Germany in the world's markets are telling American users that the moment the war is over, they will be in a position to offer the materials at a price that has never yet been dreamed of. German dye makers, it is stated, are making similar offers, and are also conducting a most skilful campaign with the view of preventing developments of the American dye industries. They have been trying to coerce the Swiss makers into not doing business with this country in its emergency. This shows the length to which the Germans will be prepared to go in order to regain their overseas trade, and resume their fostering trade campaign. It is, after all, only their old methods carried farther—even to the stage of sacrifice (if need be) in order to secure a footing once more. Our home manufacturers must be very alert—now.

Systematizing National Re-organization.

In our national affairs, the bad habit has had long duration, and has grown, of "muddling through" things somehow, until at last something happens—as it has done in this war—which brings it home that the policy is not a good and beneficial one. Even in the attempts that have been made to organize national service during the war, the War Department has been enlisting all who were willing to join the Colours; the Munitions Department has been pulling another way to get all who can help in the work of making munitions; alarm has been felt as to whether sufficient skilled men are being left at home to meet the needs of essential public services; Mr. Asquith has pointed out that the financial needs of the country require an enlargement of exports and a reduction of imports, but labour for production has been curtailed by national requirements in other directions. So things have been muddling along without system; and the different needs have been jostling and competing with each other for men. Now there is the National Registration Act; and it was clear that this would not avail the country much unless method were applied to the information it placed at disposal. This has been seen; and the Government have therefore appointed a Committee, with the Marquis of Lansdowne as Chairman, with the object of dealing with the whole question from a national standpoint, instead of piecemeal. One of the problems with which the Committee will deal, it is suggested, will be to determine which trades shall henceforth be excluded from recruiting. The gas industry can now show a good case for exclusion—having supplied for active service the maximum number of men who can be spared, having regard to the nature of its public duties, and the work on which it is engaged in connection with the supply of requirements for the war. At the same time, a no small part is being done in devoting the machine-shops of gas undertakings to the production of munitions into which much energy is being put by the mechanics attached to the works. There is no doubt that in connection with their organization procedure, the Marquis of Lansdowne's Committee will hear from the gas industry.

The Yorkshire Octopus.

The gas companies and municipal authorities owning both gas and electricity undertakings in the area of the Yorkshire Electric Power Company will do well to keep an eye on the strategic movements of the concern. The Bill which the Company promoted last year, and in which they had the colossal impudence to ask for preferential and unprecedented lighting powers in numerous electrically unoccupied areas—powers which would have exempted them from much that generally governs electricity supply—it will be remembered was rejected by Parliament; and the Company were given to understand that, if they desired lighting powers in the areas named, they must promote a Provisional Order in respect of each, and conform to the ordinary terms. The organs of electrical intelligence intimate that the Company are now busy approaching the local authorities in a number of small districts, with the view of applying for Orders. Among others, the Thurlstone District Council have been interviewed by Mr. W. B. Woodhouse, the Engineer and Manager of the Company, in order to see whether his eloquence could secure their sympathy and support for a local Provisional Order in favour of the Company. He told the members that the supply would be on a sliding-scale—from 1½d. per unit for street lighting to 5d. per unit for house lighting, and that cottages would be supplied with four lamps (power not stated in our source of information) at 1d. each per week. The Company are evidently prepared to offer terms with a superficially seductive appearance. There is going to be a conference of the authorities grouped round about Thurlstone in the area upon which the Company have set longing eyes.

Sugar-Beet Growing Experiments.

Sulphate of ammonia makers would, of course, like to see sugar-beet growing established in this country on the large scale; for they can do with the maximum home demand for this secondary product of the carbonization of coal. But little has been heard lately of the cultivation of sugar beet in this country; and one had almost become afraid that the efforts of some four years ago had proved abortive. The fact, however, is that (we learn from a report in "The Times"), though the area devoted to the growth of sugar beet has not increased rapidly, many of the growers who supported the movement at the start have persisted with the experiment, and show no desire to give it up. The season has not been very favourable for ordinary root crops; but it is satisfactory to know that sugar beet has well withstood the weather. One grower—Mr. John Cossey, of Raveningham, Norwich—asserts that the beet raised in South Norfolk and the adjoining part of Suffolk is the best that the district has produced. The enterprise of Mr. Cossey in this direction has been profitable for several years; and he is satisfied there is a great future for the industry in England. But progress will be slow if the Government do not lend a hand. Though his land is poor, Mr. J. Thistleton Smith, of Walsingham, Norfolk, states that he has had an average crop of 10 tons per acre; and he is quite satisfied with the crops that have followed sugar beet on the same land. This is all satisfactory; but it would be more so if there were greater emulation of the enthusiasm and work of the pioneers.

Another Fertilizer.

Another fertilizer is promised; but the time for sulphate of ammonia makers being alarmed by it is not yet. It was in the Botany Section of the British Association that Professor W. B. Bottomley, of the University of London, made the announcement of the new discovery, which is the result of six years of research. It is simply the treatment of peat with bacteria; and the result is a manure which is credited with being fifty times more valuable than two-year old farmyard manure. It is probable that the new comer is only intended to be an accessory to engender a higher state of efficiency; for Professor Bottomley pointed out that, for complete animal nutrition, in addition to proteids, carbohydrates, fats and salts, there must be the presence of an accessory food substance, and that, for the complete nourishment of plants, there must be organic matter, known as humus, in the

soil, besides nitrates, phosphates, and potashes. The substance in humus which really promotes growth has been named auximones. Some remarkable growing results from experiments were given. These are stated to have proved so attractive that the Board of Agriculture have made a grant for further research. From the commercial point of view, it is announced that the bacterized peat can be produced for a few pounds per ton; and that in all probability it will be placed on the market within the next few months.

Coal for Holland.

In the first editorial in the "JOURNAL" for Aug. 24, a strange story was told, on the authority of the "Iron and Coal Trades Review," regarding the control by the Dutch Kolenbureau of coal imported by Holland, and of the control of the Kolenbureau by Germans. The story, it appears, only requires modifying in one particular; and this is that, while there had not been actual seizure of the coal taken into the country by those importers who desire to be free from the Kolenbureau, the threat that this would be done had been held over their heads. A protesting meeting of the free importers has been held; but, as a result, no hope was given them that they would be freed from German control. Of course, as the "Review" points out, it is a grave disadvantage to the merchants who do business with Great Britain that the German element in the Kolenbureau should become acquainted with their customers and the details of their business. The British Government have their eyes upon this question; and, according to the Amsterdam "Telegraaf," the President of the Board of Trade has expressed the view that, if the Dutch Kolenbureau intend to create a monopoly in regard to imported coal, it will be difficult for England to grant licences for the export of coal to Holland. It is the view of Mr. Runciman that the Netherlands Oversea Trust should make itself responsible for the import of British coal into Holland; and, as a matter of fact, applications for licences to export to Holland must now be accompanied by a certificate from the Trust.

OBITUARY.

THOMAS BOWER.

IT is with the sincerest sorrow that we learn, from his first pupil subsequent assistant, and finally successor in chief official capacity in the West Hartlepool Gas and Water Company (Mr. Arnold Wiseman Branson) of the death of Mr. Thomas Bower, last Friday, at Llandrindod Wells, as the result of a stroke on the previous Monday night, from which he did not regain consciousness. Mr., Mrs., and Miss Bower had been staying at the Welsh health resort for some three or four weeks; and Mr. Bower was feeling much better and stronger for the change. On hearing the intelligence, Mr. Branson went at once to Llandrindod Wells; and thus enabled Mrs. and Miss Bower to make, with Mr. and Mrs. Akroyd Bower, their sorrowful return journey to Middleton St. George on Saturday, while he yesterday accompanied the body of his old chief back to the now darkened home. The funeral will be at West Hartlepool to-morrow (Wednesday). Much esteemed throughout the gas industry, a pillar of the gas profession in the North of England, the generous friend of many, from all parts of the professional ranks, and from those who have worked in any way with our friend in any capacity, will pass the deepest sympathy with Mrs. and Miss Bower, and other relatives. No man could have been more devoted as husband and father, no man evince friendship with more genuine sincerity, and no man could have secured greater confidence or loyalty from all who worked with him or under his direction. In his professional and commercial work, a quick practical perception characterized all he did; and in other respects he was precisely what he looked. Complete and direct frankness, conscientiousness, and broadness of mind were conspicuous among the qualities that so generally endeared him to all who came in contact with him.

It was only in June, 1914, we announced the then approaching retirement of Mr. Bower from the position of Engineer and Manager of the Hartlepool Gas and Water Company; and it was at the time mentioned that the long-existing official ties would not then have been severed, had it not been for the state of health of our long-time friend. On his own initiative relief from duties was brought about, as he felt that, owing to the fact that health compelled each year a number of weeks being given up to special treatment, he could not during those weeks be devoting himself as conscientiously as he had hitherto done to the Company's interests. The Directors of the Company, with the deepest regret, accepted the proposal; but only to the extent of the cessation of active official service, for they asked Mr. Bower to continue with them as consultant, and to attend Board meetings, and assist them with such advice as he could give them. With that implicit reliance, too, on his good judgment which had been established and hardened with service, the Directors asked him to take in hand the appointment of another man as Engineer and General Manager. There was one who was eminently fitted to succeed Mr. Bower, in view of his training and knowledge of the Company's business—that was Mr. Branson, who was at the time the Engineer and Manager of the Rhymney and Aber Valleys Gas and Water Company, though formerly, as already stated, he was Mr. Bower's first pupil, and subsequent assistant for six years.

It is now about thirty-one years since Mr. Bower went to Hartlepool. Eight years prior to that he was at Lytham; and his engineering training was obtained at Low Moor—one of the great seats of the iron industry—his family predecessors having been connected with the famous Low Moor undertaking for more than one hundred years. In fact, Mr. Bower was the first of the family tree, during upwards of a century, to leave the district and the Low Moor works to occupy a sphere elsewhere. He had a strenuous time at Hartlepool. In one year, there was as much as 26 per cent. increase in the gas consumption with which to deal. When he joined the Company, the output of gas was only 130 million cubic feet; the year before retirement, it was about 500 millions, despite fierce competition by electricity under the management of the Corporation. Notwithstanding low-priced electricity, the Company have been able to hold their ground; and this is an illustration of how largely it is necessary for the chief executive official of a gas undertaking to be commercially brilliant as well as so in construction and manufacture. During the long tenure of office by Mr. Bower, he practically rebuilt the Company's works, and prepared designs for an entire new 6 million per day plant on 15 acres of ground. The completion of this scheme, however, was largely held in abeyance, except that the first section of the purifying plant (1½ millions) was put down, a ¾ million a day carburetted water-gas plant erected, as well as a 1½ million holder. The price of gas was also largely decreased during Mr Bower's official *régime*, The water part of the business likewise increased considerably—in fact, at a rate greater even than that of the gas supply.

Outside the Company, Mr. Bower rendered help to surrounding gas and water concerns, both in the matter of the designing and construction of works, as well as in parliamentary matters. The whole of the time he was at Hartlepool, he was closely connected with the North of England Gas Managers' Association, and passed through the Presidential Chair. By the younger members of the profession in the Northern district, he was looked upon affectionately, and as almost a sort of professional "father."

The end has come—far too soon. Our friend will be greatly missed; and sorrow will be both keen and universal in the gas profession.

DEATH OF M. DE BROUWER.

MEMORIES are vivified as we read in "Het Gas" the announcement that "the Council of the Dutch Association of Gas Engineers have received news from the de Brouwer family that the death occurred on July 27 last, at Bruges, of M. Jos. J. M. de Brouwer. The deceased, who was an honorary member of the Dutch Association, had attained the age of 72."

It was in the "JOURNAL" for March 24, 1903, that the retort-charging machinery of which M. de Brouwer was the inventor was introduced to the gas industry—British and foreign; and prior to that the name of the inventor had been a name only to gas engineers in connection with the simple and light coke-conveyor, with its easily renewable parts, which he had designed a few years before, and which, like the charging machinery and subsequent improvements, were developed in certain technical detail and commercially by Messrs. W. J. Jenkins and Co., of Retford. From the time that we published the description of the new charging machinery, and gave an account of much else that was seen on a visit to M. de Brouwer, and which testified to his ingenuity on many sides, his name quickly became world-famous among gas engineers. Everyone recognized that from the quiet, grey-with-age City of Bruges, an engineering achievement had come which was destined to do much to revolutionize retort-house practices and construction. Charging through retorts from one side only of a bench meant that the next step must be discharging from one side. Charging into one side and discharging from the other meant machinery only on one side for dealing with the charges, coal-hoppers only on one side for feeding the chargers, and conveyors only on one side for removing the coke. It meant, in short, practically halving a large part of the equipment of horizontal retort-houses. It promised, too, a lessening of the number of retort-house operatives. Here was a great economic advance at one step; and the man who had made it was modest and unassuming, yet in his little works at Bruges enthusiastic and an engineer to the backbone. What he had done meant revolutionizing progress; and many engineers have had cause to bless his name. Economy in construction, economy in working, had their influence on the capital account and the expenditure side of the revenue account. But there was yet another thing our friend effected, and others have also had their part; and it was that, by enabling heavy charges to be put into horizontal retorts, he raised these to the level of keen and robust rivals of vertical retorts.

M. de Brouwer was a gentleman in all respects, and, as a friend, had a depth of affection which was warm and continuous. Those who knew him mourn with his family, and extend to them heartfelt

sympathy. We regret that the latter days of the well-spent life should have been darkened by the terrible sorrows which have come upon Bruges and its inhabitants. A man of deep religious convictions and naturally highly sensitive, upon M. de Brouwer the horrors of war must have made impression which told seriously upon his health. Nothing would have delighted him more than to have seen peace restored to those formerly calm and always beautiful old-world streets which he had trodden, respected highly as a citizen, through many years of his life.

News was received unofficially last Wednesday that Sergeant E. L. COTTRELL had been killed in action in the Western fighting line. Sergeant Cottrell, who held a position in the Gas Department of the Leicester Corporation, was the second son of Mr. William Cottrell, the Secretary to Messrs. C. & W. Walker. He had been on active service for more than six months.

A name well known in the gas profession figured last week in the list of war casualties—that of Private N. BRYAN DONKIN, of the 8th Rifle Brigade, the youngest son of the late Mr. Edwin Bryan Donkin, formerly Managing Director of Bryan Donkin and Company, Limited, of Chesterfield, and a great-grandson of the founder of the business in which he had been trained. He was reported missing in France, and believed to be dead. All the men in his particular trench were attacked with flame-projectors by the Germans and died at their posts.

PERSONAL.

Mr. C. E. CROCKER, the Manager of the Kalgoorlie Electric Light and Power Corporation, has been appointed Manager of the electric lighting and gas departments of the Perth (Western Australia) City Council.

An engagement is announced between KATHLEEN FRANCES HELPS, the second daughter of Mr. James W. Helps, of Berisal, South Croydon, and VIVIAN DESMOND RYAN, the younger son of Sir Gerald and Lady Ryan, of Hintlesham Hall, Ipswich.

Second-Lieutenant F. N. HOWES, who has received a Commission in the Royal Engineers, was educated at Doncaster Grammar School, and was afterwards a pupil for four years at the gas-works under Mr. Robert Watson. At the end of this time, he became junior assistant there.

It has already been notified that Dr. W. B. Davidson [who has been appointed Chemical Engineer to British Dyes, Limited] has been succeeded, subject to confirmation, by Mr. E. B. TOMLINSON as Engineer of the Nechells works of the Birmingham Corporation Gas Department. Mr. Tomlinson, who is 43 years of age, was articled to Messrs. C. & W. Walker, and he afterwards remained with them for two years, at the end of which time he went to Messrs. Robert Dempster and Sons as leading draughtsman. For five years from 1897 he was Chief Draughtsman to Mr. Charles Hunt at Birmingham; and subsequently he held at different times the positions of Acting Superintendent of the Adderley Street works, Works Engineer of the station, and Works Engineer at the Windsor Street works.

From among 67 applicants, the Directors of the Romford Gas and Coke Company, Limited, have in succession to Mr. W. D. Child appointed to the position of Engineer of the Company, Mr. JOHN C. WRIGHT, who has for the last little while been acting as Assistant-Manager to the Grays and Tilbury Gas Company. Mr. Wright was trained at the Bromley works of the Gas Light and Coke Company, under his father, who was Engineer there. Subsequently, he spent some twenty years in the service of the West Ham Gas Company, of which he was Acting Engineer at the time of the amalgamation with the Gas Light and Coke Company. It was mentioned in this column last week that the Directors at Romford had appointed Mr. C. W. BOYNS Manager (in addition to Secretary) of the Company.

The September number of "Het Gas" contains a biographical notice of Heer N. W. VAN DOESBURGH, the Manager of the Leyden gas undertaking, who was elected an honorary member of the Dutch Association of Gas Engineers at the annual meeting held last July—*ante*, p. 189. From the notice, we gather that in 1881 Heer van Doesburgh took up a position as Engineer of Public Works in the Dutch Indies, but returned home in 1886, and was then for a short time at a spirit works at Delft. He then took charge of the Maessluis Gas-Works; and in April, 1888, he transferred to the Dordrecht Gas-Works, and in 1890 to Assen. In 1891, he became Assistant Manager of The Hague Gas-Works, where he remained until May, 1898, when he was appointed Manager of the Leyden works. Heer van Doesburgh became a member of the Dutch Association of Gas Engineers in 1888; and in 1899 he was appointed Secretary to the Association, which office he held for fifteen years. In 1907, he was Editor of "Het Gas." He has also acted as Secretary of the Coal Commission of the Dutch Association. Last year, however, under doctor's advice, he relinquished most work which was not of a strictly official character, but continued that of the Association until it could be taken over by the Central Bureau. Heer J. H. JANSON is now Editor of "Het Gas," and Manager of the Central Bureau of the Association of Dutch Gas Engineers.

GAS ACTS FOR 1915.

[THIRD ARTICLE.]

IN addition to local authority measures in which gas affairs had part, there were certain Electricity Supply Bills and Scotch Provisional Orders which were reviewed early in the year—the former in the "JOURNAL" for Jan. 12, and the latter in that for Jan. 19. The Electricity Bills were those promoted by the London County Council and jointly by a number of the London Electricity Supply Companies—the two being competing schemes—and by the Yorkshire Electric Power Company. In view of the vastness of the proposals contemplated by the Bills referring to the Metropolitan and much adjacent area, and the extent of the opposition raised, the Government declined to enter upon the consideration of the schemes this session—their desire being to devote it solely to the war and to imperative national matters. We should imagine that the coming session will find the Government similarly disposed, and not desirous of having such measures revived. It is probable that the promoters, good sense prevailing, will not attempt to push the measures forward again until the war is at an end. As to the Yorkshire Company's Bill, it contemplated powers that were not in accordance with the general legislation affecting electricity supply for lighting and other purposes, and Parliament rejected it.

Regarding the Scotch Provisional Gas Orders, there are only three Confirmation Acts to notice, owing to the dropping of the Cowdenbeath and District Gas Company's Order, and to the fact that the measure promoted by the Lanarkshire County Council has not yet received the Royal Assent. This leaves the Forfar, Glasgow, and Port Glasgow measures as the only ones to be reviewed for the purpose of ascertaining the differences that may have arisen since Jan. 19.

The Forfar Corporation asked for additional borrowing powers up to £20,000; but the sanction is for £12,000 with power to apply to the Secretary for Scotland for such further sums as may be requisite. The provisions relating to the authority to demand prepayment for a period of three months or shorter period, and to the power to purchase waggons and trucks for the purpose of conveying gas-works materials, are missing; but the other points noticed when surveying the Bill, together with a number of modern general clauses, are in the Order. [*Parliamentary Agents: Messrs. Wm. Robertson and Co.*]

In the Glasgow Corporation Act, confirming their Provisional Order, the power has been conferred to construct a bridge over Adelphi Street, commencing within the Dalmarnock Gas-Works on the south side of the street, and terminating in the works on the north side of the street, together with all necessary buildings, works, machinery, and apparatus connected therewith, or incidental thereto. The new works are to be deemed part of the gas undertaking, and are to be completed within five years. [*Parliamentary Agents: Messrs. Martin and Co.*]

The Port Glasgow Gas and Burgh Extension Order Confirmation Act confers the lands and works clauses sought; but in connection with the power to maintain gas-works, the model residuals provisions have been inserted, including the obnoxious restriction as to the purchase rights not exceeding one-third the quantity of the home production. Power is given to purchase the Langbank Gas Company's works. Succeeding is a clause allowing the Corporation to contract for the supply of gas in bulk. The next one stipulates that "nothing in this Order shall authorize the Council to supply gas in the Burgh of Greenock." The proposed calorific standard has been altered from 550 B.Th.U. (total heat test) to 540 B.Th.U., in accordance with the model and accompanying conditions. The prepayment meter clauses have been adjusted to standard form; but the clause has been expunged which proposed to impose upon the prepayment meter users liability for both meter and money therein. The old clause, common to Scotland but not to England, as to preventing wilful waste of gas has also been removed. In the Order, the Corporation asked for borrowing powers to the amount of £70,000. This has been reduced to £55,000, exclusive of the purchase of the undertaking of the Langbank Gas Company. There are no other variations that are worth mention. [*Parliamentary Agents: Messrs. Beveridge, Greig, and Co.*]

ELECTRICITY SUPPLY MEMORANDA.

IN the report of the Departmental Committee on Lighting in Factories and Workshops, this statement appears: "We have had many general expressions of opinion that insufficient light and excess of light, especially when accompanied by glaring sources of light in the field of vision, are responsible for injury to the eye. While it is doubtless true that such unsatisfactory conditions lead to mental and physical strain, we have not received any concrete evidence of cases of actual disease of the eye." For the information of the Committee, Mr. F. Richardson Cross, F.R.C.S., representing the Royal College of Surgeons, the Royal Society of Medicine, and the Ophthalmological Society of the United Kingdom, made numerous inquiries among the ophthalmic surgeons on this aspect of the question; and an epitome of the results is given in Appendix XII. to the report. Reading the replies, it is interesting and satisfactory

Electric Light and Eyesight.

to find that, although gas lighting has such extensive use in factories and workrooms, there is not a single instance recorded of complaint having been made to the ophthalmologists of this system of lighting. Several of the replies, however, mention complaints by people working under the electric light; but the ophthalmic surgeons do not appear to have made inquiry as to how this is. Dr. W. Ernest Thomson, of Glasgow, acknowledges he has had "*many* complaints of electric light as cause of eye trouble; but, in the end, refraction error is often found to be the whole cause of the trouble." Now Dr. Thomson should piece together his own conclusion with that of Dr. A. S. Cobbledick, of London, who admits that he "sees *many* clerks who work all day by electric light, and who complain particularly of metallic filament lamps." He is of opinion that "this light brings out refractive error very quickly. Correcting glasses only partly relieve them of discomfort." Dr. W. B. Inglis Pollock, of Glasgow, states that he "has cases of postal sorters who complain of the lights in the sorting hall. He has found congestion of the optic nerve due to light shining directly on the man's eyes." Dr. J. Walton Browne, of Belfast, has had brought to his notice "some cases of conjunctival trouble caused by unprotected electric lights." Then Mr. M. Stephen Mayou, F.R.C.S., deprecates "light sources which are rich in ultra-violet rays, and is in favour of indirect lighting." Mr. J. Arthur Wood, M.B., of Hereford, is of opinion that bright sources of light are serious factors in the question." He also quotes from Behr in the "Archives of Ophthalmology, 1913," demonstrating chronic injury of the eye by artificial light in four cases, showing itself in impairment of the adaptation to dark without objective trouble. There is always considerable disturbance of the adaptation to dark in aphakic eyes; and he attributes it to the intense action of the ultra-violet rays.

A Preference and a Poor Foundation.

This testimony shows the quarter from which proceeds the cause of complaint and injury. It is not merely a question of giving a "dog a bad name." Since people have been working under electric lights, complaints have increased, and so has the work of ophthalmic surgeons. Most of those who replied to Mr. Richardson Cross's inquiries, urge that electric lights should be shaded. Of those who spoke of the complaints as to the noxious effects on the eyesight of electric light, only two express an opinion as to which kind of artificial light they prefer—Dr. W. B. Inglis Pollock, and Mr. J. Walton Browne. But they qualify selection by requiring strong barricades to resist the eye-injuring properties of the electric light. Dr. Inglis Pollock wants the light reflected from the ceiling. Dr. Walton Browne only prefers electric light "if well covered by a shade." "If," he remarks, "the lights are not covered by a shade, which seems impossible in some places of business, it is difficult to avoid shadow and glare." Then Dr. Clements Hailes, of Bristol, says he prefers "electric lamps, with diffusing bowls below;" but we see elsewhere that Dr. Hailes has "no information of diseases or affections arising from faulty lighting in factories." Mr. C. G. Russ Wood, F.R.C.S., of Shrewsbury, who apparently did not make a report upon eye effects, points out that metallic filament electric lamps cause more glare than carbon filaments." He "prefers holophane covers for avoiding this trouble." Dr. T. Harrison Butler, of Coventry and Leamington, who "has seen no eye trouble which can be fairly ascribed to defective illumination of workshops," has a liking for "mercury vapour lamps in the roof, supplemented by movable incandescent lamps with top shades;" but "the mercury lamp must not be placed near the work, on account of ultra-violet rays, which would cause ophthalmia electrica." Mr. W. Beaumont, of Bath, "where sunlight is impossible, prefers electric light, at the zenith, sufficiently strong to give a good light on the work." But here again this gentleman, with the existing systems of lighting in the factories in the Bath district, has had no complaints of workers unduly suffering from eye trouble. Then Mr. J. Elliot Square, F.R.C.S., of Plymouth, who makes no report as to eye effects, favours electric light placed about 8 feet from the ground—the shade being of ground glass. Now it would be particularly interesting to ascertain from these gentlemen why, with some ophthalmic practitioners acknowledging a shoal of complaints through electric lighting, there should be a preference for that light, but a preference always accompanied by a recommendation that the eyes should be well protected from the light. Is the preference due to the composition of the electric light being better *in their view* than that of gas light? Is it because gas light requires a certain amount of oxygen for combustion purposes; and that these gentlemen have overlooked the fact that Dame Nature has a chemical factory of her own, and from it provides compensations for work that has to be done in using her gifts? If neither of these is the explanation, what is it? Have these gentlemen really studied the relative intrinsic brilliancies of different lights, and the compositions of the lights. Dr. F. W. Edridge-Green, F.R.C.S., of London, says the artificial illuminant which has the nearest composition to average daylight is the best. Which is that light? Investigators of the spectra of different lights award to gas light a nearer approach than electric light to the spectrum of sunlight.

Practical Considerations.

It seems to us that these few gentlemen have pronounced a preference without having thoroughly investigated whether the foundation for it is of a solid character. Time is constantly adding to the illustrations of the inconsistencies of idealists. Why is it that our ophthalmic friends recommend so consistently that the electric light requires so much shielding from the eyes? There is only one answer. Because of its harmful effects beyond those of other illuminants of less intrinsic brilliancy and different composition. Why is it there is such little complaint of incandescent gas light? Because of its comparatively low intrinsic brilliancy, and its composition more consistent with the light of the sun. The ophthalmic surgeons look at the matter entirely from the point of view of the eyes, and recommend shields, indirect lighting, and so forth. They do not regard the matter from the practical point of view of light in relation to both work and eyesight. They only take in one factor, and omit the important one of work. While they do this, and recommend for factory purposes indirect lighting and shaded lights, the National Physical Laboratory have carried out tests with workers to ascertain the quantity of light required by them, and find that the operatives, from the point of view of work, object to any form of indirect lighting, and prefer direct lighting; that with the former they require from 40 to 100 per cent. more light at the source than with the latter—particularly where the work is fine detail; and that when working upon different coloured material different degrees of illumination are required. The preference of certain of the ophthalmists is apparently ill-considered from the practical point of view. What do the tests at the National Physical Laboratory teach? That indirect lighting is not preferred by those who have to work under the light; that it is not an economical system for the employer, on account of the additional electrical energy required and the extra expense of equipment and maintenance; that the workers themselves prefer a direct light; and so *à fortiori* the light used should preferably be one of low intrinsic brilliancy and good composition. There is too much consideration given to-day to the ease of lighting and extinguishing, and not sufficient thought accorded to the quality of the light between the time of lighting-up and extinguishing. We commend the point to the deeper consideration of those ophthalmologists who have pronounced a preference, but whose opinions, the Committee themselves say in their report, afford but "little positive evidence."

Aged Men, Gaslight, and Eyesight.

We should like to call the attention, too, of the ophthalmic specialists to another fact found in Appendix XIII. of the report. But this may be prefaced by the remark that the bulk of operatives in factories use incandescent gas-lights in the living and best rooms of their homes; and the workers who consult the ophthalmists do not complain of the effects of the lights in the home, but of the electric lights (the report tells us there are "many" of these complainers) in the workroom and the office. In some weaving and lace factories in the country, antiquated lighting is still to be found. Gas managers have considerable trouble in getting the factory owners to bring their lighting up to date by the installation of modern incandescent burners; but where the factory owners are wise, they do so in the interests of economy and improved lighting. But what do we find as a result of the letter that was addressed to certain operative associations by the Joint Secretaries to the Departmental Committee (Messrs. D. R. Wilson and C. C. Paterson)? The Secretaries of the Weavers' Association and of the Association of Beamers, Twisters, Drawers, and Machine Workers were unable to state offhand specific cases of bad eyesight due to bad lighting, though one of them admitted that there had been general complaints of the difficulty of working on account of indifferent lighting. But an interesting letter was from Mr. C. Wardle, Secretary of the Amalgamated Society of Operative Lace Makers. He wrote:

> It would be a very difficult matter to give you a specific case of injury to eyesight caused by insufficient lighting, as, for instance, take the case of two men working the same machine, and under exactly the same conditions—one may require glasses at a very early age, where the other one may dispense with glasses up to quite an old age.
>
> *A large percentage of our superannuated members have quite good eyesight;* and it may be contended that in their days the artificial light would not be so good as at present. This may be so; but in those days, they would have at least two lights to machines which were but 2 or 3 yards wide—the very widest being 4 yards wide, while we are working machines to-day 5 or 6 yards wide, with but two lights. Then, again, the modern machine is speeded-up to nearly double the number of motions per minute to what obtained in the old days.

Now our ophthalmic friends may be recommended to ponder the words: "A large percentage of our superannuated members have quite good eyesight." These men worked in the days of old low-power, low intrinsic brilliancy gas-lights, and not in the days of metallic filament lamps which the ophthalmologists say should be shielded or used in indirect manner, while the workers assert that they prefer direct lights, in order the better to see and deal with the detail of their work. Then give the workers the lights from which there is the smallest danger when unshielded, and which, if shielding be deemed necessary, requires the least amount. From practical experience and testimony, even ophthalmologists may learn something.

No Revolutionary Increase in Efficiency.

In our columns recently, Mr. H. C. Widlake was discoursing on questions which have relation to electric-motor efficiency. The President of the American Institute of Electrical Engineers (Mr. Paul M. Lincoln) has, also

lately, been addressing himself to tracing the progress of some of the developments and practices in electrical matters; and he comes to the conclusion that the rate of progress must in future be slower than in the past, and that, if there are to be revolutionary improvements in the future, these must come from a fundamental change in method rather than from the continued improvement of existing methods. Mr. Lincoln sees, for example, little room for increasing the efficiency of the electric-motor, because the available margin for this is very narrow. He says it is a safe statement that the average efficiency of the conversion of mechanical into electrical energy by generators, or electrical energy into mechanical by motors, including all sizes, under actual operation, will reach 90 per cent. But because the size of the average electrical generator is much greater than that of the average motor, and because the generator can be operated at higher average loads than the motor, the average efficiency of converting mechanical into electrical energy is higher than that of the reverse process; and therefore, while the average generator efficiency is well above 90 per cent., it is doubtful whether the average motor reaches so high a figure. From his premises, Mr. Lincoln deduces that no development of a revolutionary character can be looked for in this respect. The ability to convert mechanical energy into electrical and *vice versâ* has reached so high a value that, even if perfection itself could be obtained, only a matter of 10 per cent. could be added to what has already been accomplished.

TRADE UNION CONGRESS.

Record Attendance at Bristol.

Last year, on account of the war, the annual Trade Union Congress was abandoned; but when the time came round for another of these labour functions, it found the country still at war. It was, however, decided to go forward with the congress on this occasion; and the event duly took place last week, when Bristol enjoyed the pride of a record attendance of over 600 delegates, who assembled to deal with an *agenda* long enough and varied enough to satisfy the most exacting of Labour Leaders. At the very opening of the proceedings there was an air of strangeness; for the customary civic reception was dispensed with—surely, an unwise, as well as an unnecessary step to take, at a time when differences between Capital and Labour should be forgotten in the desire to do the best possible for the country. However this may be, there was no civic reception, for the reason, as explained by Mr. J. Widdicombe (the President of the Bristol Trades Council), that "they in Bristol had no sympathy with such an important industrial body being welcomed by a representative of the class which they were unceasingly fighting for the rights of their trade unions." But there is another sort of fighting to be done now; and in connection with the consideration of this aspect of affairs, as touching Labour—which, to do the congress justice, it may at once be admitted occupied most of the attention of the delegates throughout the week—the "representative of the class" referred to might have been able to afford some assistance. As it was, Mr. Widdicombe himself extended the welcome.

The meeting then settled down to the Presidential Address of Mr. J. A. Seddon, who pointed out that the present one was the forty-seventh gathering of its kind. After a few words hinting at a concerted effort to mobilize all their forces to meet more effectively the power of organized Capital—in the course of which he remarked that, however strong might be their convictions, "light on the subject is preferable to heat"—the President found himself in the midst of the all-absorbing subject of the war, and problems arising out of the war—including the employment of Belgian labour, the high cost of living, women's labour, and war profits. After a protest against "the locusts of trade, who have been permitted, by inflated prices on coal, food, freight, and war requirements, to gravely menace national unity, and create irritation highly dangerous to success in our great struggle," the President went on to say they had been told that war profits would be regulated, and this promise should be carried out.

Some routine business having been transacted, a suggestion was put forward to the effect that the Parliamentary Committee be instructed to prepare a manifesto, or "new workers' charter," which should embody the economic changes repeatedly suggested by the congress resolutions. But the idea proved to be unpopular, for there was only one delegate in its favour—the proposer. The next resolution, however, proved to the liking of those present; and it mildly called for such a reform of parliamentary procedure as would enable private members' measures to be carried from stage to stage and from session to session, until they are either placed on the Statute Book or rejected. Next the Government were called upon to place all works of construction and buildings, including demolition, repair, or reconstruction of such works or buildings, under Government inspection, so as to afford workers the same protection as is enjoyed by those engaged in mines and factories. Under prevailing conditions, there seems little practical use in the instruction to the Parliamentary Committee to promote legislation at an early date to secure that superannuation and other trade union and friendly society benefits, or any private help of a financial character, should not be taken into account in assessing an applicant's income for the purpose of old-age pensions; and the same remark applies to the "demand" that the Government shall institute a national scheme of pensions for widows and orphans at the earliest possible opportunity.

Interest on Tuesday morning mainly centred in the debate regarding conscription, to which method of raising an army the congress proved unanimously antagonistic. The resolution, thus carried without a dissentient, set forth that the delegates to the congress, representing nearly three million organized workers, recorded their hearty appreciation of the magnificent response made to the call for volunteers to fight against the tyranny of militarism, and emphatically protested against attempts that were being made "to foist on this country conscription, which always proves a burden to the worker, and will divide the nation at a time when absolute unanimity is essential." The opinion was added that "no reliable evidence has been produced to show that the voluntary system of enlistment is not adequate to meet all the Empire's requirements;" and the belief that "all the men necessary can, and will, be obtained through a voluntary system organized." Mr. Ben Tillett, in a rousing speech, said he wanted the congress to tell the Government very frankly that the whole of the trade union movement, and they believed the whole of the labour world, was at their back; and he further declared that, though he was opposed to conscription both on practical and theoretical grounds, if he believed it would help to end the war sooner he would vote for it straightaway. There were, he added, more than a million trade unionists at the front; and the Government had no right whatever to enforce conscription until they had consulted them. Mr. Havelock Wilson, on the other hand, said he did not know of any time when Labour had been more consulted than during the progress of the war. Mr. R. Smillie, on behalf of the miners, argued that it was want of organization among those at the head of affairs that was largely to blame for the present state of matters. After this debate, the proceedings seemed a little tame, till an announcement was made by the President of the receipt of a telegram from Mr. Lloyd George, in response to the remark in his address which had called for the fulfilment of the promise made to deal with war profits. The telegram pointed out that, under the Munitions Act, 714 firms have already been placed under control, to the extent of limiting the profits so that the benefit of any suspension of trade union regulations shall ensue to the State, and not to the employers. This being so, Mr. Lloyd George quite fairly urged the delegates to persuade their unions throughout the kingdom to carry out their part in the bargain by suspending during the period of the war all regulations and practices which have the effect of restricting the output of material "so urgently required for the protection of our gallant troops at the front, and for the achievement of victory for the nation."

Hours of work figured among the discussions on Wednesday. The Parliamentary Committee were first requested to use their influence with a view to securing the passing into law of the Railwaymen's Eight-Hours Bill; and later a resolution was declared in favour of a Bill to generally limit the day's work to this period. A suggestion seemingly originating from a desire to make things, in certain circumstances, as uncomfortable as possible for employers, and of which the congress approved, was to the effect that unions negotiating with employers on matters which might ultimately lead to a dispute, should give timely notice to other unions likely to be immediately affected, so that joint action might be secured, if thought desirable. Previous decisions as to the establishment of a 30s. minimum wage for all adult workers were re-affirmed; but remarks made showed the possibility of this figure soon being regarded as an insufficient minimum. One delegate [unfortunately unnamed] announced his discovery of the fact that the advances in wages were cancelled by the advances in prices. Where did he think previously that advances in wages would be likely to come from, if not from the consumers of the commodities concerned? The congress then further pledged itself to assist the Government as far as possible in prosecuting the war.

On the following day, Mr. Lloyd George responded to an invitation to attend and explain his telegram already referred to; and in a characteristic speech he succeeded in getting in some home truths, and concluded by making a powerful appeal to his hearers "not to let the sympathy of the country be against labour by holding back its might by regulations, fetters, and customs, when the poor old land is fighting for life." And this appeal he made after showing clearly that there was dire need for it—after proving that in many cases munition workers and others are not doing, and are not allowed to do, their best.

In the course of the business transacted on Friday—which was of a very miscellaneous character—the President referred to the weighty words of Mr. Lloyd George; and it is to be hoped that the delegates will use the powerful influence they possess to secure the carrying into effect of their own resolution "to assist the Government as far as possible in the successful prosecution of the war," by allowing the war workers to put their best efforts into the tasks on which they may be engaged. The President said the Parliamentary Committee, who had held a protracted meeting, were seriously concerned at the statements made by Mr. Lloyd George, when he charged certain trade unionists with a breach of their undertaking with the Government to withdraw restrictions on output. He said they had evidence that since the outbreak of war trade unionists had loyally endeavoured to assist the Government, and to carry out their pledges. The Committee would take immediate steps to investigate the charges, and would then issue a report.

The congress came to an end on Saturday, when a number of resolutions remaining on the *agenda* were disposed of—including one calling for more factory inspectors.

GERMAN HYGIENE APPLIED TO GAS.

A CRITICISM OF PROFESSOR M. VON GRUBER'S WORK.

By W. J. A. Butterfield, F.I.C., Assoc.Inst.C.E.

The lecture, on "Gas and Hygiene," which was delivered by Professor M. von Gruber, at Munich, in July last year, and of which a comprehensive summary has been published in the last two numbers of the "Journal" [*ante*, pp. 449, 510], may possibly be accepted as the conclusive verdict of science on the hygienic aspects of gas lighting by persons who have the general impression that scientific research, if done in Germany, is necessarily beyond criticism. The writer, having a fairly long and close acquaintance with German methods of investigation of scientific and technical problems, suffers under no illusion on this score. As Professor von Gruber's lecture presents a flagrant instance of incompetence and futility in an investigation of which the results and conclusions, if not now challenged, may be accepted in some quarters without question, he thinks it opportune to offer some criticism of Professor von Gruber's work.

Professor von Gruber's Qualifications.

It should be borne in mind that Professor von Gruber is the successor in the chair of hygiene at Munich University of so distinguished and trustworthy an authority on hygiene as Pettenkofer. Probably it was largely on this account that the German Association of Gas and Water Engineers applied to Professor von Gruber when it required an authoritative and exhaustive investigation and report on gas and hygiene. But it was an unfortunate choice. On general grounds, it may be said that, for an investigation of the practical bearing of the use of an industrial product in everyday life, it was unwise to apply to the occupant of a professorial chair. With the exception of most of the older generation of professors, as typified by Pettenkofer, and a few of the present generation such as Professor H. Bunte, who throughout their careers have been concerned with technical matters, the professor (in Germany, in particular) is, by reason of his associations, unlikely to bring sound judgment and good sense to bear on the elucidation and exposition of such problems. In addition to labouring under this general disability of his class, however, Professor von Gruber appears, from the evidence afforded by his lecture, to have been exceptionally ignorant of scientific research carried out elsewhere than in Germany bearing on the subject dealt with. Such ignorance—apparently due in the first instance to disparagement of researches made in other countries—has, indeed, been noticeable in a very large proportion of the German professoriate in recent years; and it indicates the curious and rapid growth among them of an insularity surpassing that with which men of other nations have in the past been more or less unjustly accused. Technical men in Germany display this insularity in a much less marked degree than their academical colleagues; and on this account the German Association would have been better advised to have sought out a technical consultant to undertake the research on gas and hygiene instead of Professor von Gruber. Unfortunately, however, the independent consultant is very rare in Germany owing to the national tendency, which has become more and more pronounced of late, to exploit the official subsidized by the State or Municipality at the expense of private initiative. One consequence of this tendency is that the professor, who is essentially a servant of the State, comes to believe that he is impeccable, and that his conclusions and pronouncements are infallible. Being backed by State authority, they are, indeed, generally so received in his own country. This apotheosis of the professor is demoralizing for him and bad for the public.

Professor von Gruber appears to have set about the investigation which the German Association of Gas and Water Engineers asked him to undertake, with preconceived opinions and prejudices which augured ill for an impartial study and report. Towards the end of his lecture, he confesses that, at the outset, no one at the Munich Hygienic Institute "doubted that gas lighting was inferior to electric lighting for living-rooms in respect of the air, since electric lighting does not contaminate the air, develops no moisture, and produces little heat. It was a question of the extent of the difference between the two." He accepts electric lighting, as used by him in the experimental room, as an ideal condition. If it really represents his ideal in respect of hygienic requirements, hygiene as understood at Munich University appears to be on a very low plane. The writer would be sorry to spend many evenings in the living-room lighted by electricity which Professor von Gruber took for his standard of ideal living-room conditions. In a room which approximates to a sealed chamber, electric lighting should obviously be less trying to the unfortunate occupants than gas lighting; but in respect of a room ventilated to meet the ordinary hygienic requirements of a living-room, Professor von Gruber has failed entirely to establish that his initial prejudice in favour of electric lighting has any justification.

Destruction of Micro-Organisms and Smells by Gas Lighting.

He refers, in the course of his lecture, to statements emanating chiefly from this country, that gas lighting purifies the air, destroys smells, and tends to disinfect the air of rooms; that its warmth considerably improves ventilation; and that as a consequence the air of an occupied room which is lighted by gas is better than that of one lighted by electricity. He does not give the authority for any of these statements, still less does he refer to the investigations on which they were presumably based. The statements, as quoted by him, are broader than the writer remembers reading in the writings of any English scientific or technical authority; but there are experimental data of a higher grade than Professor von Gruber's in support of rather more definite statements to similar effect. Professor von Gruber even supplies data supporting some of these statements in an unexpectedly conclusive manner; but in these cases he chooses in his conclusions to override the evidence of his own work. One striking instance of this will suffice.

Professor von Gruber proceeded to test the contention which he says came from England, that gas lighting disinfects living-rooms by destroying the organisms in the air. Experiments were carried out for him by a colleague. He gives the results, but considers that the differences which they show between the number of organisms in the air of the gas-lighted and the electrically lighted room is inconsiderable, and of no practical significance. The contention to which Professor von Gruber here refers may have been drawn from several English sources; but it was expressed in moderate and sufficiently precise language, in 1903 and again in 1910, in the text-book on "Acetylene" by the late Mr. F. H. Leeds and the writer, in the following words:—

> There is one respect in which acetylene and other flame illuminants are superior to electric lighting—viz., that they sterilize a larger volume of air. All the air which is needed to support combustion, as well as the excess of air which actually passes through the burner-tube and flame in incandescent burners, is obviously sterilized. But so also is the much larger volume of air which, by virtue of the up-current due to the heat of the flame, is brought into anything like close proximity with the light. The electric glow-lamp, and the most popular and economical modern enclosed electric arc-lamp, sterilize only the much smaller volume of air which is brought into direct contact with their glass bulbs. Moreover, when any large numbers of persons are congregated in insufficiently ventilated buildings—and many public rooms are insufficiently ventilated—the air becomes nauseous to inspire, and positively detrimental to the health of delicate people, by reason of the human effluvia which arise from soiled raiment and uncleansed or unhealthy bodies, long before the proportion of carbonic acid by itself is high enough to be objectionable. Thus a certain proportion of carbonic acid coming from human lungs and skin is more harmful than the same proportion of carbonic acid derived from the combustion of gas or oil. Hence acetylene and flame illuminants generally have the valuable hygienic advantages over electric lighting, not only of killing a far larger number of the micro-organisms that may be present in the air, but, by virtue of their naked flames, of burning-up and destroying a considerable quantity of the aforesaid odoriferous matter—thus relieving the nose and materially assisting in the prevention of that lassitude and anæmia which occasionally follow the constant inspiration of air rendered foul by human exhalations.

There is evidence from English sources justifying these contentions; but the experiments made by one of Professor von Gruber's colleagues substantiate the principal contention in a conclusive fashion. He introduced organisms into the air of each of the rooms, and at definite intervals took measured samples of air and determined the number of organisms therein. The average results of the series of his tests show that the percentage proportions of the original number of organisms left in the air of each room after the lapse of the following times from the commencement of the test were as follows: At one hour, gas-lighted room 60, electrically lighted room 77; at two hours, gas-lighted room 38, electrically lighted room 58; at three hours, gas-lighted room 22, electrically lighted room 42; at four hours, gas-lighted room 14, electrically lighted room 32; at five hours, gas-lighted room 9, electrically lighted room 23; at six hours, gas-lighted room 5, electrically lighted room 17. If figures obtained by Professor von Gruber and his co-workers are of any value at all, those quoted clearly demonstrate that gas lighting has a very destructive action on micro-organisms in the air of the room. It is indeed surprising that, in face of them, he gives vent to his prejudice, and commits himself to the statement that he considers the difference inconsiderable, and of no practical importance. This inference, drawn in spite of his own experimental data to the contrary, stamps his judgment and all his deductions as entirely worthless.

Not less purposeless, though more ludicrous, are Professor von Gruber's efforts to demonstrate that gas lighting has no destructive action on the odoriferous matter in air rendered foul by human or other animal exhalations. His method of testing the validity of the contention that gas lighting has a greater effect in this direction than electric lighting consisted chiefly of observations of the persistency and pungency of cigar smoke in the two rooms, one lighted by gas, the other by electricity. Cigar smoke —itself the product of carbonization and partial combustion— obviously would be little or not at all affected by contact with heated surfaces or momentary passage through flame. No one but a professor, and a German at that, would have resorted to

cigar smoke as a reasonable experimental alternative to human or organic effluvia. The smell of *sauerkraut*, which was the only other sufficiently familiar and penetrating to appeal to Professor von Gruber, is scarcely less ludicrous than cigar smoke as a subject for testing the validity of the proposition advanced in the paragraph quoted from the text-book on "Acetylene." The smell of *sauerkraut* is due to fairly definite and stable compounds —such as acetic acid—and obviously would not be affected by contact with heated surfaces or flame to the same extent as the smells, directly derived from organisms, referred to in the quotation. Thus, as regards any reasonable claims which have been advanced in this country for superiority of gas over electric lighting in respect of the destruction of micro-organisms and effluvia in the air of a living-room, Professor von Gruber not only does not disprove the claims, but in so far as his experimental work bears on them at all, he substantiates them. Nevertheless, he advertises his prejudiced attitude by stating, in the face of his own proofs to the contrary, that he disbelieves these claims.

The Ventilating Action of Gas Lighting.

Professor von Gruber's study of the effect of gas lighting on ventilation is very unsatisfactory, chiefly because he chose and prepared for his experiments rooms which were practically devoid of natural ventilation. Gas lighting had, therefore, no opportunity of increasing ventilation which was practically non-existent. The state of ventilation, or rather want of ventilation, normally in the rooms which he used for his tests will be readily appreciated from consideration of the figures given in Table IV. of the summary of his paper [*ante*, p. 510]. The room contained a little over 2000 cubic feet of air-space. In this room, without gas lighting, he kept five people for four hours. The air-space per head was therefore 400 cubic feet, which is 150 cubic feet per head more than the legal minimum for factories and workshops in this country. Nevertheless the carbonic acid resulting solely from breathing of these five people raised the proportion in the air to nearly 32 parts per 10,000. The generally accepted maximum for the proportion of carbonic acid in the air of factories and workshops is 12 parts per 10,000. It is obvious, therefore, that the normal ventilation of Professor von Gruber's experimental room, in the absence of gas lighting was so low as to be negligible. The room was, in fact, unfit for occupation as a living-room, judged by reasonable hygienic standards. It is not surprising, therefore, that when Professor von Gruber kept eight persons in this room for six hours—the cubic space per head being the factory allowance of 250 cubic feet—it required the use of only one gas-burner to raise the proportion of carbonic acid in the air to 65 parts per 10,000. When the number of people was increased to twelve, it is also not surprising that, in the absence of gas lighting, the air in this experimental room showed as much as 125 parts per 10,000 of carbonic acid—an atmospheric condition which would not be tolerated for a moment by the occupants of any factory, workshop, or living-room in this country. What good purpose could be served by proceeding to demonstrate the effect of gas lighting in a room in which the air was so stagnant as to become, from breathing alone, intolerable to the occupants?

A point in Professor von Gruber's work which needs clearing-up is how he determined the ventilation in the experimental rooms throughout the tests. He does not describe the method he adopted; and the results are, quite apart from any question of gas or other lighting, the reverse of what would be expected. The effect of an increase of temperature in a room in all ordinary circumstances is to increase the ventilation; but Table I. [*ante*, p. 451] and Table IV. [*ante*, p. 510] show that rise of temperature in the experimental rooms at Munich had the effect of decreasing ventilation. It would almost appear to one familiar with methods of ascertaining the ventilation of a room that Professor von Gruber had blundered either in his mode of determining the ventilation or in calculating the results, since they are quite contrary to general experience and probabilities.

Bearing in mind the unsuitableness in respect of ventilation of the experimental rooms, and the uncertainty as to the measurement of the rate of ventilation, it should really be very gratifying to adherents of gas lighting that the condition of the air in the gas-lighted room differed so little from that in the electrically lighted room that even Professor von Gruber states that the differences are not sufficiently great to come into consideration from the hygienic standpoint, and that they do not indicate that gas lighting is undesirable in living-rooms. This conclusion he believes can be accepted with entire confidence.

(*To be continued.*)

Eastern Counties Gas Managers' Association.—A circular letter, signed by the President (Mr. W. B. Farquhar) and the Hon. Secretary (Mr. Joseph Davies) of the Association states that at a meeting of the Committee it has been decided, after due deliberation, for reasons that will be patent to every member of the Association, to postpone until the spring of next year the general meeting usually held in the autumn. That the routine business of the Association may be carried on, a meeting of the members will be held at the Liverpool Street Hotel, Hertford Room, Bishopsgate Street, on Thursday, the 30th inst., at 3 o'clock in the afternoon. No address will be presented or papers read. The only business to be transacted will be the induction of the incoming President and officers, the reception and passing of applications for membership, and such other business as may be brought forward.

BENZOL RECOVERY FROM TOWN'S GAS SUPPLY

By W. R. Herring, M.Inst.C.E.

The question of increasing the available supply of benzol and kindred products arising from the carbonization of coal was never more insistent than at the present time; and, as I have had occasion to deal with this question not only from a gas engineer's but from other points of view as a commercial proposition, it may be of interest to record the conclusions arrived at.

Technical achievement does not always imply a commercial possibility. The history of tar products is so prolific in commercial changes that a problem which is unsound commercially at one period is quite a different matter at another. Perhaps at the present day, it is not correct to look upon it as a commercial proposition at all, but rather one of urgent national necessity. It is, therefore, the duty of all who can help to do what is possible to facilitate its recovery.

I recently had occasion to approach this subject from a different point of view, such as many others are engaged upon at the present moment, and that was the recovery of toluol without depreciating the luminous and calorific value of the gas. The suggestion put forward by Dr. Colman and others was that a benzolized oil used in the washer would enable the toluol to be extracted from the gas without materially affecting its luminous and calorific values; and, in order to put this theory to the test and so as to prepare the staff and educate them to the working of a large plant, I had certain experimental workings carried out on plant in Edinburgh that has afforded important and reliable information.

In organizing the course of research, it was desired to make the experiments correspond as nearly as possible to practical working conditions, and such as will prevail with the larger plant. The apparatus used was a small rotary washer, 4 ft. 6 in. long by 2 ft. 6 in. diameter, of the Holmes type; and the necessary tanks and receptacles for the wash-oil and effluents and connections were duly installed. The capacity of the washer was determined in relation to a 5 million unit of coal-gas plant; and the portion of wash-oil used, the rate of flow of gas through the washer, and the rate of flow of oil through the washer were all established on lines exactly parallel to the working of a much larger unit. The following conditions of working were observed :—

Straight coal gas was taken from the outlet of the meter.

The scrubbing oil used was a light grade coal tar oil, specific gravity ·9862, flash point 151° Fahr. close test.

The amount of gas passing the scrubber closely approximated 500 cubic feet per hour.

The rate of flow of oil entering the scrubber was to be 25 gallons per 10,000 cubic feet.

The operations were to be continuous.

The scrubber was filled with the wash-oil, and then the gas and oil were turned into washer in proper quantities; the oil (once it left the washer) passing off into separate receptacles for each day's run. Straight coal gas and the scrubbed coal gas were conserved in accurately proportioned quantities in two separate holders.

The first series of experiments was directed to show the effect of washing the straight coal gas with an unbenzolized oil; and, in order to determine this, a three days' run was occupied and the fullest details were kept by the analysis of the gases both chemical and otherwise.

To summarize the results. It was found that a 16·11-candle gas (No. 2 "Metropolitan" burner) was reduced to a 10·51-candle gas —showing a loss of 34·7 per cent. of luminous value. Its calorific value was originally 585·3 B.Th.U. gross; and it was reduced to 559·1 B.Th.U., or a loss of 4·5 per cent.

The next series of experiments was directed to establish the effect of benzolizing the wash-oil. The conditions of working were the same, and the wash-oil used was the same. To it, however, was added 5 per cent. of benzol—the benzol used having a specific gravity of ·880, boiling at 80° C., all distilled at 92° C. and containing no toluol.

To summarize these results, it was found as a result of nine individual days' working that a gas of an average power of 16·08 candles was reduced to 15·06 candles, or a loss of 6·34 per cent., and its calorific value of 579·4 B.Th.U. was reduced to 576 B.Th.U., or a loss of 0·58 per cent.

The results of these investigations seem to clearly establish the correctness of the suggestion that a benzolized oil containing something between 4 and 6 per cent. of benzol is an effective washing medium for the extraction of toluol without making any material change in either the candle power or the calorific value of the resulting gas. The point, however, that will strike gas engineers more than any other is the comparatively insignificant loss of calorific value when using an unbenzolized oil. It goes further to establish the fact that a very large percentage of the benzol constituent of the gas can be eliminated, and still leave a candle value sufficient to give some luminous effect when burnt as a naked flame.

If this can be established, and I have no doubt or hesitancy in saying that it can, and in view of the national necessities at the present moment and the certainty of there being a future market for benzol for motor-traction purposes, the question arises as to

whether the time is not opportune to press for such an enactment as will free, once and for all, the entire country from:

(*a*) The incidence of the luminous flame test.
(*b*) Establish in its stead the calorific test at such a value as will not materially vary from the common value of to-day's supply—viz., 500 B.Th.U. gross.

Bearing in mind the position taken up by a House of Lords Committee presided over by Lord Clinton, and their expressed view that the gas should retain some degree of luminosity when burnt as a naked flame, it will be necessary to show that the removal of the benzol constituent will not entirely eliminate luminous value. The figures already quoted, which can doubtless be supported from many quarters, should be sufficient to establish this point, and that the luminous value remaining can only be destroyed by over-exhaustion in the process of manufacture or by dilution with a non-luminous gas, such as water gas.

The gas industry is not strong enough to bring about such a vital change, excepting over many years, through Private Bill enactments; but there is little doubt that a common enactment, applicable to all, would be welcomed in a vast majority, if not all, towns. It will not materially alter the real value of the gas, but only its fictitious value when burnt by means which the public generally do not employ.

REFINEMENT IN GAS-FIRES.

The "Classic" Series of Fletcher, Russell, and Co., Limited.

ADVANCES in the construction and efficiency of gas-fires could never have left us with such incongruities as the old repellent types which were an eyesore in most rooms, though accepted on account of their one virtue of utility. There is no reason at all why any gas-fire should be offensive through ugliness, because, as a rule, the ugliness means waste of metal. The makers of gas-fires, fortunately for the gas industry and themselves, have during latter years made huge departures in designs; and from crude styles, we have reached a refinement which in itself, while extending the scope of adoption, also adds to utility, by reducing the quantity of the heat-absorbing metal work, which promotes convected heat, and as a consequence detracts from radiant efficiency.

Messrs. Fletcher, Russell, and Co., Limited, in the new designs which they have brought out for the coming season for adoption in recessed fire-places, have made a distinct hit. As a matter of fact, what will be known as their "Classic" series of designs in fires for this particular purpose will be, we are certain, on the tale of the illustrations alone, voted as taking premier position among their best efforts in this line of productions. Here we have the artistic beauty given by lightness and clearly defined form, and yet with ornamental features which will enable the cleanliness, the heating utility, the constancy, the adaptability, the convenience, and all else associated with the modern gas-fire, to be incorporated in the most choice of fire-places, such as those of the "Jacobean" and "Adam" styles. This is what is wanted by the architect, whose services are being sought and utilized more and more in the execution of renovations and new decorative and furnishing schemes. He is the man whose interest is worth cultivating, and whose notions as to the fitness of things have to be satisfied. The architect cannot fail to appreciate that in these new designs he has not only something that will meet the economic and hygienic requirements of his clients, but that he can introduce the fires with the confidence that they will not offend the most fastidious tastes in refinement and congruity.

Take the first illustration. It is identified as the "Boscobel" No. 1. It has a crown and oakleaf pediment, and is a graceful production. So is the "Burleigh" No. 1, with its scroll pediment. "Burleigh" No. 2 is not included here; but it is equally good in the lines of its design, and has a fan-shaped pediment. The "Boscobel" No. 2, with Tudor rose pediment, is illustrated. All are attractive; and the difficulty will be for those who have to make choice of one or the other to say which has some superiority to turn in favour the balance of preference.

The fires are all fitted with patent non-lighting-back burners; and, needless to say, with Messrs. Fletcher, Russell, and Co. as the producers, the castings are fine, and so are the finishes—best art black, armour bright, and bronze. In the bronze finish, the fires look very handsome.

While the makers of gas-fires, who have already reached high standards in efficiency, construction, and outward styles, continue to so successfully seek for yet further improvement, and to meet changes in requirement, the gas industry can see before it an illimitable field for the expansion of their heating business. To enabling compliance with the industry's opportunities, Messrs. Fletcher, Russell, and Co. have made good contribution.

DAMAGE TO FRENCH GAS-WORKS BY THE WAR.

THE opening article in the current number of the "Journal des Usines à Gaz" is on the subject of the effects of bombardment upon gas-works generally, and some French ones in particular. It appears that, before the present war, information in regard to the destruction caused by projectiles of all calibres to the various installations of plant constituting a gas-works was confined to observations, made in the course of the war of 1870, in Paris, Strasburg, Metz, and a few other places. The power of the material employed in that war cannot, however, be compared with that of the munitions now in use; and, moreover, account must be taken of the large number of projectiles thrown from aeroplanes.

The first gas-works struck during the present war were those at Mulhouse. In the bombardment which took place on the night of the 9th-10th of August, 1914, the two gasholders were badly damaged by shrapnel and balls. The side sheets were pierced and the gas escaped, but fortunately was not ignited; and as soon as firing ceased the holes were easily plugged. The other portions of the plant sustained but little damage, with the exception of the breakage in three places of the mains on the works. The necessary repairs were quickly effected, and the consequence was that the lighting was interrupted for hardly 24 hours in one part of the town, and for only 48 hours in another part.

Reference has already been made in the "JOURNAL" to the damage done to the gas-works at Rheims [see Vol. CXXX., p. 458]. On the 15th of June last, 111 projectiles had been thrown into them; the portions of the plant chiefly injured being the exhauster and station-meter house, the purifier-house, the station governor, and the gasholders. There are five holders, and they received nine shells, some of large size. These generally burst when they came in contact with the sides of the holders, but in no case was the escaping gas ignited. In the case of one of the small holders—the first erected on the works—damage was done by the bursting of a shell at a distance of about 8 feet, and a considerable number of holes were made in the side. Portions of the shell went right through the holder, and came out on the opposite side as well as at the crown; but the gas escaped without ignition. Some minutes afterwards, however, another shell burst on the off side of the holder, and fired the gas, which burnt itself away. When the holder grounded the flames were extinguished without causing any explosion.

The "Gas Age" (New York) lately gave some particulars—(obtained probably from a German publication—of the effects of the shells thrown at the holder at the Münster Gas-Works, in Upper Alsace. As in the preceding case, the gas was not fired by the striking projectiles; but one made a hole 5 feet long and 8 inches wide, which allowed of the rapid escape of the gas. In the evening following the accident, when military operations had ceased, the staff on the works proceeded to repair the holder by covering the hole with a sheet-iron plate. This was done entirely by the light of small electric lamps, in order not to attract attention; and it was finished by daybreak.*

Particulars reached our French contemporary of the damage done to a gasholder in the region of Flanders—probably the one at Ypres. A considerable number of projectiles struck the crown and the above-ground metal tank (the latter being pierced with holes more than 6 feet in diameter); while the guide-framing was entirely broken.

These particulars show that in gas-works under bombardment it is the holders which have suffered most. This is quite understandable from the fact that they are extremely tempting targets

* See "JOURNAL" for June 22 last, p. 697.

The "Boscobel" No. 1. The "Burleigh," No. 1. The "Boscobel" No. 2.

MESSRS. FLETCHER, RUSSELL, AND CO.'S CLASSIC SERIES OF GAS-FIRES.

for the enemy. Generally speaking, the pipes in the ground have not suffered when they have been laid at sufficient depths. When the projectiles have fallen on places covered with paving, explosion has had only a minimum destructive effect, as the shock produced on contact with the paving has made the shell burst before it has penetrated the soil, and the pieces are scattered above the ground without breaking the pipes. The particulars further justify the conclusion that projectiles which attack gasholders do not fire the escaping gas.

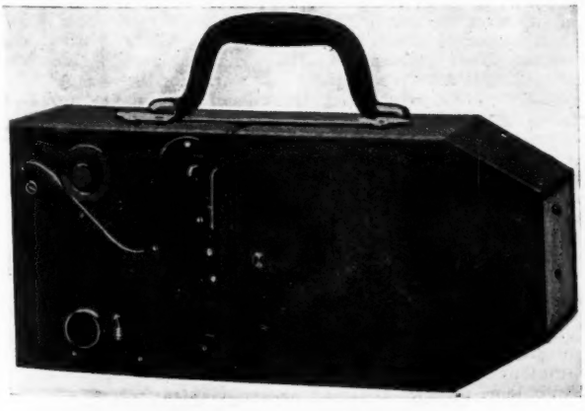
From what has been said, the conclusion may be drawn that certain precautions can be taken to protect the plant in a gas-works as far as possible from the effects of bombardment. They may be summarized as follows: For pipes or underground structures, it will suffice to cover them with a paved surface or with sheet-iron plates, planks, &c., which will throw off the projectile before it can bury itself in the soil. For gasholders, it is absolutely necessary, in order to prevent the entrance of air, to secure the free upward movement of the lifts. To do this, if, after the fall of different projectiles, flames of gas are produced which cannot be extinguished, steps must be taken to ensure the cooling of all the guide-framing, &c., attacked by these flames, so as to prevent it from losing its shape. So far as stopping-up the holes is concerned, there are a number of ways which are well known to gas managers. The distribution plant suffers to a greater extent than would be generally supposed from the effects of the fall of projectiles; and in all cases where the town mains have had to sustain bombardment there should be a careful examination of the whole of them. This will reveal the need for the repair of a great number of broken pipes, and especially of unsound joints. Evidence of this has been furnished recently in the case of distributing systems of not very great importance.

In the course of the article, reference is made to the damage done to the gas-works at Hartlepool and Scarborough, particulars of which have already appeared in the "JOURNAL."

PHOTOGRAPHIC RECORDS OF METER-INDICES.

IN last week's issue, p. 494, a paragraph appeared regarding the proposal of the New York Consolidated Gas Company to take photographic records of their meter indices, so as to retain permanent records, in place of leaving the readings entirely in the hands of the employees. The last number to hand of the "American Gaslight Journal" gives particulars of the apparatus employed and the operations involved—accompanied by two illustrations which are reproduced pending the receipt of fuller details of this interesting development.

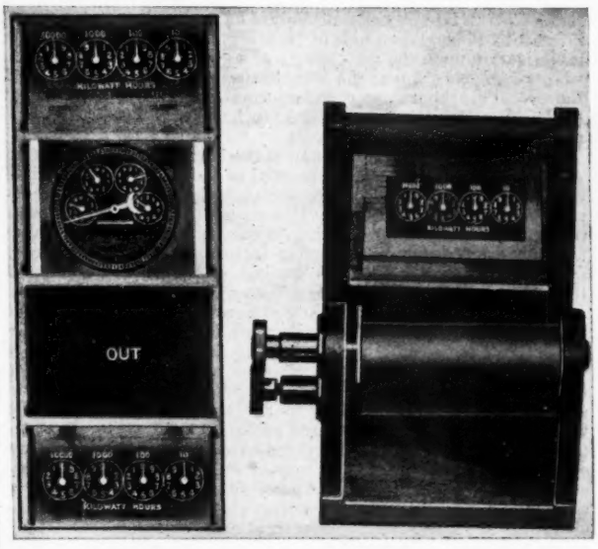
According to our contemporary the special camera employed has been developed by the Folmer and Schwing division of the Eastman Kodak Company, of Rochester, N.Y., for the use of meter-readers, who can thus bring to the office at the close of the day's work photographic records of the dial-pointers on the meters of the customers visited. To "take" the reading, he simply holds the camera opening against the dial glass and



Electric Lighted Camera for Recording Meter-Readings.

presses a lever, which automatically opens the shutter for a definite period, and at the same time lights four small battery-operated lamps to illuminate the dial. After each exposure, the shutter is locked; and it cannot be operated again until the film-roll has been advanced for the next picture. The device can also be used as a flash-lamp in dark passage ways, by pressing down the lever part of the way, without operating the shutter.

A roll of film is sufficient for 75 exposures, and costs 25 c. Two additional rolls can be carried inside the camera box—making a total of 225. The film consists of an emulsion on opaque paper, backed-up with a white coating that makes the image on the developed film show clearly, although reversed right and left, mirror fashion. The developed film is examined by mounting the rolls on a stand and reading the reflection in a mirror. As the customer's name and meter number are marked on each dial, the



A Film and the Stand for Examining Meter-Index Records.

photograph leaves no doubt as to the identity of the reading. If the customer is "out" the meter-man notes this fact on a card, and photographs it for his record.

The "Factograf" camera, as it is called, provides a definite photographic record of the condition of the customer's meter, and avoids all possibility of misreading or future controversies. Such evidence, it is pointed out, is especially useful in the case of maximum-demand meters, where, ordinarily, the meter-reader notes the position of maximum-demand pointer, and then sets it back to zero—thus destroying all record of its position.

THE BRITISH ASSOCIATION MEETING IN MANCHESTER.

THIS year's meeting of the British Association, which concluded in Manchester on Saturday, has been somewhat remarkable in several respects. In the first place, while the attendance—as reflected in the reception room crowds just prior to the sectional meetings each morning—fell considerably short of the average, nevertheless the attendances at the meetings of those sections with which we are more directly concerned struck one as distinctly above the average. The reason no doubt is that chemistry and engineering are playing a very important part in the nation's affairs just now; and there was every prospect of some action being taken officially by the Association, through recommendations from the sections. This undoubtedly gave a fillip to some of the meetings; but it does not altogether account for what appeared to be larger attendances than usual.

Another direction in which the meetings of the Association generally may be regarded as exceptional—this is entirely due to the times in which we live—was the general desire for organization in every department of science. In more than one of the Sectional Presidential Addresses hints were thrown out that the Association as a body was disposed to take action; and as the week proceeded a more or less definite state of affairs developed. Indeed, it is not too much to say that it is not at all improbable for the Association to take over the whole organization of the science of the nation—delegating the details to various Sectional Sub-Committees. A perusal of our report of the proceedings below will show how far the idea has progressed.

The main Presidential Address—that read by Professor Arthur Schuster, F.R.S., in the Free Trade Hall on Tuesday night does not directly interest us—it is incidentally referred to in our editorial columns—and we turn to the sections.

By far the most important (to the gas industry) Sectional Presidential Address was that of Professor W. A. Bone to Section B (Chemistry), which was delivered on Wednesday morning. It is given—practically *in extenso*—on pp. 576-82 of to-day's issue.

Section B was the only one to meet on Wednesday afternoon. Professor Harold B. Dixon dealt with the explosion of gases; Dr. H. F. Coward, with the dilution limits of inflammability of mixed inflammable gases with air; and Professor W. A. Bone, with gaseous combustion at high pressures. They were all interspersed with experiments and lantern slides; and to do justice to them needs greater length than either the authors had time at their disposal or we space. Several matters touched upon will doubtless be the subject of communications to other societies under more favourable circumstances as to time.

Smoke Prevention.

On Thursday, in Section B, a discussion took place upon smoke prevention. We pick out the direct references to gas. Professor BONE was in the chair.

The PRESIDENT, in opening the proceedings, remarked upon the

importance of the subject, especially in industrial districts. Special interest had been taken in it in Manchester, where almost the first investigation upon the atmosphere of a great city was made some twenty-five years ago at the Manchester University by Dr. G. H. Bailey. This report was very important, historically, apart from its merits. He (Dr. Bone) desired to have it recorded that this report existed.

Mr. E. D. SIMON (the Chairman of the Manchester Air Pollution Advisory Board, which was appointed in 1903) said this body had been considering the relative importance of different lines of research in smoke abatement. There were three possible lines of research: (1) Questions relating to the damage done by smoke; (2) improved means for reducing factory smoke; (3) improved means for reducing domestic smoke. While it was computed that the damage done in Manchester and Salford by smoke amounted to £1,000,000 per annum, nevertheless it was felt that the question of damage done was much less important, as a line of research, than the other two lines of research mentioned. It was, however, the domestic problem which seemed to offer the greatest field for laboratory research. This aspect of the subject could be divided into four main branches. First, the variations in efficiency as regards radiation of heat and production of smoke between existing types of coal-burning grates were enormous. Knowledge in this respect was in a very rudimentary stage. Secondly, there was the possibility of the production at a commercial price of a semi-coke or coal, which would burn as cheerfully as coal and as smokelessly as coke. He understood that a new company had been formed to sell such an article, and hoped that it would be successful. Thirdly, there was the adaptation of open fires for the burning of coke. Finally—perhaps most important of all—there were gas-fires. Valuable work was being done in this direction in Leeds, London, and Birmingham; but much remained to be done before a gas-fire was procurable which would give out radiant and convected heat in the best proportions, which would not allow leakage of gas into the room, and which would give the right amount of draught up the chimney. The Manchester Committee having considered these various matters, had undertaken two lines of research. It had decided to join in the national investigation as to the deposition of soot, and was measuring at ten different stations. The second line of research was the fitting-up of a room at the School of Technology for the purpose of carrying out tests on various kinds of domestic heating appliances. This was controlled by Special Sub-Committees including representatives of the City Gas and Electricity Departments, whose co-operation should be of considerable value. The work consisted of the measurement of radiant heat, flue gases, testing gas-fires for leakage, and any other tests which experience might dictate. Promising attempts were already being made to devise a standard method of measuring the total radiant heat given out by a fire. If this were possible, it would greatly facilitate improvements in gas-fires and open coal-fires. If the Board were successful, it would be able to give independent and authoritative advice as to the best type of heating appliance to instal under any given conditions—having regard to questions of cost, heating power, and ventilating effect. At present, the public were thrown back on the advertisements of manufacturers in trying to determine the relative efficiencies of heating appliances; and the work of the Board should enable better guidance to be given to architects and the public than was available at the present time. It should be possible for the Board to make a reasonable charge for any tests made, or advice given; and the department should in time become self-supporting. The most hopeful line of progress was in the endeavour to secure that bituminous coal should not be burned as such, but only after being turned into products which could be smokelessly consumed. With regard to factory smoke, it was not felt that any great progress could be made at present, although the increased use of producer gas was encouraging. In domestic smoke, however, very great progress was to be looked for. It should be possible to confine the coal-fire to the sitting-room; all cooking and bedroom heating should be done by gas or electricity; and it should be possible to ensure that the few open fires that were left should be of a construction which would give off very much less smoke than was at present the case. He did not think this was an impracticable ideal; and if it could be accomplished, it would mean the abolition of the domestic smoke nuisance. The precedent set by the Manchester City Council, in appointing its Board, was a valuable one; and he hoped it would be followed by others. A Central Committee might even be formed, which might very possibly be a Committee of the British Association, to co-ordinate the whole matter. At present, perhaps there was not much to co-ordinate; but such a Committee could do valuable work immediately.

The PRESIDENT, in calling upon Mr. Yates, said that manufacturers of gas-fires had of late gone in for a great deal of scientific investigation. It was not confined to one firm. He had had the pleasure of supplying, from his laboratory, chemists who left him to go to the gas-fire makers; and it was interesting to hear what his late pupils had to say about one another.

Mr. H. JAMES YATES spoke at considerable length on the subject under discussion; and his remarks were of so much importance as to justify giving them apart from this general notice of the proceedings—see p. 586.

The PRESIDENT, referring to the supply of cheap gas, made some strong comments upon the policy of assisting the rates out of the profits of municipal gas undertakings. Sheffield (not a municipality gas supply, by the way) and Birmingham were examples of the right policy, and Glasgow was moving in the same direction. But Manchester continued to tax consumer to the extent of some £50,000 per annum by the "pernicious and senseless custom" of relieving rates out of gas profits. This was the one instance in which Manchester was to be censured for not adopting a sane policy in connection with its municipal affairs. It was a bad policy from every point of view; and he urged the consumers to take steps to compel the Gas Committee to give it up.

Mr. ARNOLD LUPTON said he had calculated that the loss to tradespeople in Leeds through damage by smoke was equivalent to a rate of six shillings in the pound; and he also estimated that the evil could be cured at an expense equivalent to a rate of a shilling. This, however, was in the nature of a prophecy; and he had no means of substantiating it except by experiment, for which the necessary funds were not available. One way towards helping a solution was to punish and reward—*i.e.*, reward those who made no smoke, and not merely punish those who made smoke. He was, of course, speaking from the industrial point of view. To do this it would be necessary to erect watch-towers, from which smoke inspectors could see with telescopes who made smoke and who did not.

Mr. WALTER REID urged the necessity for having manufacturers on any Committee which might be formed. In dealing with the domestic smoke nuisance, advocates of other forms of apparatus than coal were sometimes rather apt to overstate their case. Take, for instance, a block of workmen's dwellings. The tenants were told that, if they put in gas, they would find it so much cheaper, that labour would be saved, and so on. But in such circumstances no labour was saved. This was all right as an argument when there were servants. There were also great difficulties with the gas companies themselves. Only the other day, he had occasion to consider putting in gas in an old office. When he went into the question, however, he found that the cost of the pipes, meters, &c., before he consumed a single cubic foot of gas, was one-and-a-half times as much as the cost of coal for a whole year. These things must be considered. If a cheap appliance was put into the workman's house to burn cheap gas, he would use it. They must not certainly expect such tenants to spend money in having the appliances fitted.

The PRESIDENT, in bringing the proceedings to a close, said that the suggestion for the appointment of a Committee which was now under consideration included not only the prevention of smoke, but fuel economy and the proper utilization of coal.

The Manchester Gas-Works.

The most important paper before Section G (Engineering) was on Thursday, when Mr. J. G. Newbigging, M.Inst.C.E., the Manchester City Gas Engineer, read "Some Notes on the Manchester Corporation Gas Undertaking." See pp. 588.

There was an official visit to the Rochdale Road Gas-Works in the afternoon. As a matter of fact, the works were open to visitors throughout the whole time of the meeting.

Professor H. S. Hele-Shaw's Presidential Address to Section G.

On Wednesday, the President of Section G proposed the formation of a new Committee to deal with scientific and engineering organization. The object of the proposed new Committee would be twofold. The first would be to undertake any work which might be of use in an advisory capacity or by research, or indeed in any other way, for direct assistance in the war. This would be a temporary object of the Committee. With regard to the second object, this stood on rather a different footing. We were, he said, in many respects quite unprepared for the war on which we have entered; and though this offered one of the most powerful arguments in refutation of the charge that we deliberately entered the war for sinister purposes, it would be very disastrous if we repeated our unpreparedness when the war ceases. When peace was concluded, it would only be the prelude to another war, and a war which would recommence with far greater energy on the part of our enemy than before—viz., the war of commerce; and the latter would be almost as serious for us in England as the more sanguinary one. The second and the real object of the proposed Committee, therefore, was to undertake a permanent organization of science in directions in which Germany had achieved such wonderful results. A few of the matters touched upon by Professor Hele-Shaw as affording most ample scope were education, research (there would be prevention of overlapping between institutions and individuals engaged in research), standardization, exhibitions, patents, and general organization. The underlying idea of the scheme, it would seem, would be that the British Association should take over (by means of a Permanent Committee and Sub-Committees) all the research and scientific organization work of the country—work now being carried on in a scattered fashion by numerous investigators. Another subject dealt with in the address—viz., the relationship between employers and employees was dealt with separately later.

Following the Presidential Address on Wednesday, Professor J. E. Petavel submitted a short paper by himself and Professor G. Asakawa, entitled "Experimental Investigations of the Thermal Efficiency of the Gas-Engine"—see p. 590.

Next a short note by Mr. W. M. Thornton, on "The Total Radiation from a Gaseous Explosion," was presented—see p. 590.

On Thursday, after Mr. Newbigging's paper (which appears on p. 588), Mr. E. C. Mills briefly described and exhibited a model of his gas-producer—see p. 590.

THE MONO-RAIL TELPHER.

ITS INSTALLATION, CARE, AND MAINTENANCE.

By H. C. Widlake, M.J.Inst.E., of the Plymouth and Stonehouse Gaslight and Coke Company.

(*Continued from p.* 502.)

Standard Mono-Rail Telpher.

In fig. 6 is shown a photograph of a standard mono-rail telpher by Messrs. Strachan and Henshaw. This machine is suitable for handling almost any class of goods or material—the lifting attachments being specially designed to meet the requirements of the user. The entire weight of the machine is carried upon two free

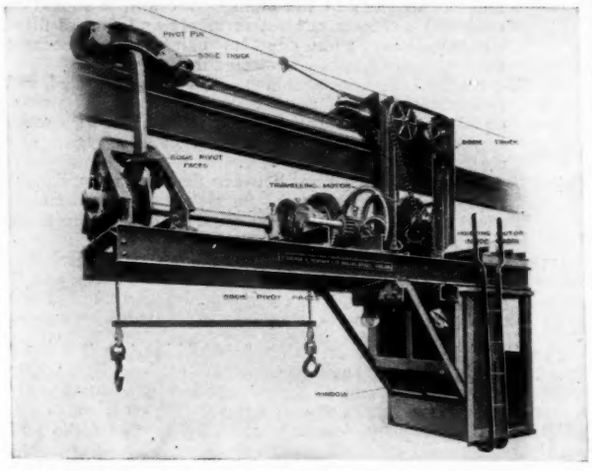


Fig. 6.—Strachan and Henshaw's Mono-Rail Telpher.

swivelling bogie trucks fitted with manganese steel wheels, the axles of which are carried in roller bearings. The usual hoisting speeds are in the neighbourhood of 60 to 80 feet per minute; while the travelling speeds vary from 500 to 700 feet per minute, according to the work for which the machine is used.

The bogie construction enables the machine to negotiate the sharpest curves without the slightest tendency to bind, even with the heaviest loads; the bogies being free to adjust themselves instantly to the slightest change in level or direction of the track. The frames of the machines are made of mild steel throughout—no castings being used structurally; while the whole of the gears are of machine cut steel.

The electrical equipment consists of two series-wound crane motors controlled by a main controller and a change-over switch. The connections between these respective appliances are shown diagrammatically in fig. 7. In many machines these two motors are often quite identical in electrical and mechanical detail—a practice which tends to keep the stock of spare parts at a minimum. Both motors have their armature shafts projecting through the end shield bearings at both ends, so as to form a seating for a pinion or brake drum, according to the purpose for which they may be used.

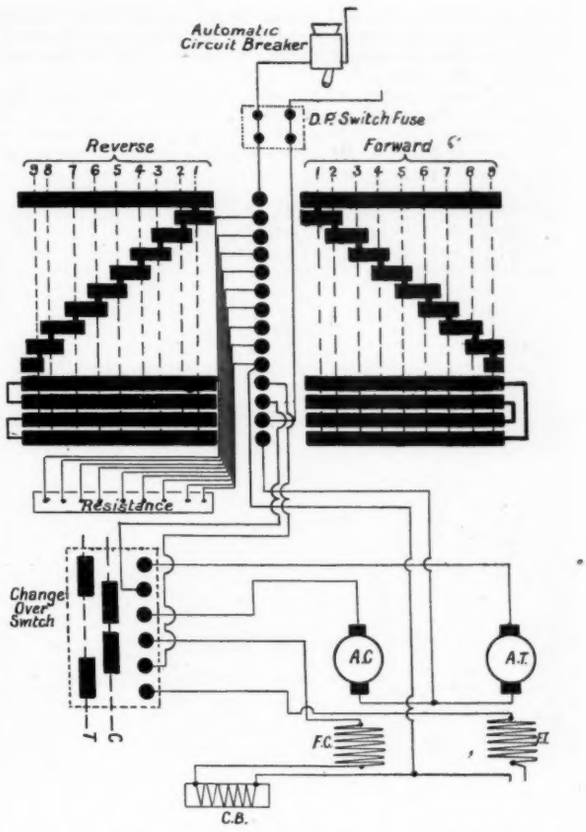
The Travelling Motion.

The travelling motor is generally situated just above the roof of the operator's cab, where it is carried by a large steel plate, which is so secured to the main frame of the machine as to permit of its being readily raised or lowered in order to effect any adjustment in the driving chain. At the end of the motor farthest from the commutator, a pinion keyed on the projecting shaft transmits the power to the track wheels, *viâ* a driving chain and two chain wheels keyed on extensions of the travelling wheel shafts passing through the roller bearings on the side of the bogie truck. The elevation of this chain-drive is in the form of an inverted triangle, the apex of which is formed by the pinion on the travelling motor shaft. The travelling bogie is furnished with toggle brake gear operated by a pedal in the driver's cab.

Hoisting Motion.

The simplicity and efficiency which are the chief characteristics of the travelling gear are among the most striking features of the hoisting motion. The hoisting motor is situated in the body of the machine just above the level, and a little forward, of the driver's head; the axis of the motor being parallel to the horizontal centre line of the telpher. The shaft extension of the armature nearest the driver is fitted with a brake drum, on which a solenoid brake operates in such a manner as to release the motor only when current is passing through its windings.

On the other shaft extension a pinion is seated, and is always in mesh with a spur wheel mounted on a lay shaft at the side of the machine and a little above the motor. This short lay shaft carries at its front end a sliding pinion controlled by a lever inside



C. Hoisting Leads. T. Travelling Leads. CB. Hoisting-Motor Selenoid Brake. AC. Hoisting-Motor Armature. AT. Travelling Motor Armature. FC. Hoisting Motor Field. FI. Travelling Motor Field.

Fig. 7.

the cab, by means of which it can be thrown in or out of mesh with the spur wheel on the hoisting drum shaft. This drum is fitted with a substantial hand brake working independently of the electric solenoid brake on the motor and lever controlled from the driver's cab. A special feature of this control is that an interlocking gear renders it impossible to throw the hoisting motor out of gear before the hand brake is applied. One or two—according to the electrical arrangements—small trolley collectors convey the current from the overhead wires to the controller, *viâ* a switch fuse. One set of resistances is employed; and the frame containing the cast alloy grids is situated under the driver's seat—a short run of cables connecting it to the controller.

Change-Over Switch.

On the telpher installation at the works of the Plymouth and Stonehouse Gas Company a special form of change-over switch is employed; and the excellent results given by this appliance quite justify a short description of it, and of the circumstances which led to its design and adoption.

There is at the works an installation of the Fiddes-Aldridge simultaneous charging-discharging machines; the last machine being put down in the autumn of 1913. The engineering staff of the Company, after a close series of observations of the standard "F.A." machine, had arrived at the conclusion that the general handiness and all-round capabilities of the machine would be enormously increased by the use of an additional motor in connection with the travelling gear. In the early part of 1913, a design was drawn up embodying the use of two motors, worked by a master controller and a change-over switch; and an order was placed with Messrs. Aldridge and Ranken for a new machine to be built in accordance with this design.

The machine was built and set to work a few months later, and the excellent results it gives have more than justified this radical departure from Messrs. Aldridge and Ranken's standard design. The capacity of the new machine (No. 83) is at least 25 per cent. in excess of that of the standard machine. Before placing the order for the machine, it was recognized that the change-over switch with which it was intended to equip the new machine might prove a source of trouble, owing to the large number of times which such an appliance would be operated in the ordinary course of the day's work.

On the basis of 22 benches working on eight-hour charges, it was estimated that the change-over switch would be operated 1000 times a day. This calculation was based on the assumption that the operator brought his machine right into the charging position each time, and never over or under shot his mark. This

accuracy of operation is, needless to say, not attained in actual practice; it being more probable that, under the conditions outlined, the change-over switch would be operated between 2000 and 3000 times a day.

The general opinion was that there was not a change-over switch on the market which would stand-up to this particular job without giving a great degree of trouble; and a special switch (of which a short description follows) was designed by the author and constructed on these works. Its performance and endurance leave nothing to be desired; and as soon as it proved its worth on the new "F.A." machine, the telpher was equipped with a similar switch with the most gratifying results.

Fig. 8 shows two of these switches—one assembled and the other taken apart—the height of the boxes being about 12 inches. It is practically a double-pole two-way switch arranged on the barrel controller principle. Two gun-metal drums of opposite polarity are keyed concentrically on a gun-metal shaft, and are insulated from it by leatheroid. Each of the drums has three grooves turned around its periphery for the reception of, and in

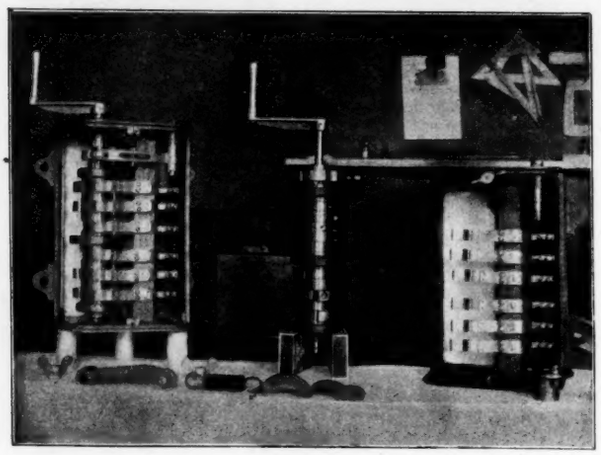


Fig. 8.

order to ensure the alignment of, the copper contacts secured to the drums by radially projecting screws. A hard-wood carrier fitted the entire length of the cast-iron switch case has mounted upon it six saddle-pieces of gun-metal, whose lower ends form terminals for the reception of the cables; while the upper ends are tapped and screwed for the screws securing the fingers.

A substantial internally contained cam gear prevents the controller barrel being left or vibrating into any position other than its two legitimate ones. All parts are liberally rated; and trouble from this, or indeed, from any other, cause has been practically non-existent during the nineteen months the switches have been used on the Fiddes-Aldridge and the telpher installations at these works. The design can be easily adapted to enable a master controller to control three or four motors *viâ* this switch; while provision is made for the use of a magnetic interlocking device, which renders it impossible to operate the switch unless the master controller is in the "off" position.

Maintenance.

The satisfactory operation of any machine depends largely upon the manner in which it is handled and looked after. Periodical inspection can do much to minimize the chances of a breakdown; and while it is obviously impossible to have a telpher working in the neighbourhood of stacks of coal in the same condition as (say) the engines in a generating station, still no effort should be spared to keep the whole of the machine in a reasonable state of cleanliness. This remark applies especially to the neighbourhood of the controller, the motors, switchgear, &c.

The most remarkable feature of these telpher installations is the extremely small maintenance charges involved; and in this connection the author frankly admits that when he came to write under the above heading he felt himself to be somewhat at a loss for material—so small have the maintenance charges been in connection with the plant under his charge for the last few years. This experience is, he believes, by no means uncommon. On a properly controlled plant every machine should come in for regular periodical inspection, the period elapsing between the inspections being dependent upon the working hours of the machine. In the case of a telpher plant handling (say) the coal in an average provincial gas-works, the inspection should be carried out every week or ten days; the following routine being observed:

(1) All grease-cups should be inspected and filled, and all bearings, &c., cleaned.
(2) Travelling and hoisting brakes should be inspected and, if necessary, adjusted, and the electric solenoid brake adjusted in the manner described at length at the end of this section.
(3) The travelling chain should be cleaned, lubricated, and, if necessary, adjusted by raising or lowering the motor.
(4) All nuts and bolts should be inspected and, if necessary, tightened-up.
(5) The end bearings of the motors should be emptied, flushed out with paraffin, and refilled with clean oil after making sure that the lubricating rings are free. Particular care should be taken to see that the oil plugs are tight in the end shields; and if a plug is known to be slack in its thread, it should be replaced.
(6) The motors, controller, change-over switch, fuse-box, circuit breaker, and resistance should be blown out with a strong pair of bellows and thoroughly cleaned.
(7) The motors having been cleaned, the clearances between the pole pieces and the armature core should be taken by means of feelers, the carbon brushes should be tested to see that they are free in their holders, and fresh brushes put in where necessary.
(8) The wear and spring of the contact fingers in both the main controller and the change-over switch should be observed and new contact segments and fingers fitted where necessary; the contacts being lightly smeared over with vaseline before closing-up.
(9) The trolley collectors should be inspected and oiled, and new wheels fitted if necessary. An old wheel, however equally worn, will throw the collector off the wire when travelling, and lead to a smashed collecting gear and perhaps a broken trolley wire.
(10) All electrical connections between the various appliances should be thoroughly tried for tightness; the old electrical axiom being borne in mind "good connections, good results."
(11) The trolley being removed from the wire, the insulation resistance of the entire machine should be taken, and, if low, the various appliances should be disconnected and the faulty portion of the equipment located.

The above list may seem rather formidable; but it will be found easy to get over the entire inspection in two or three hours, while the additional feeling of security gained by so methodical a procedure will more than wipe-out the trifling cost, not to say anything of the incipient defects which may be discovered and put right before a breakdown occurs.

A very simple, yet important, point to observe is to never start inspecting or doing anything to the machine before making sure that the grab is lowered to the ground, the current switched-off the telpher circuit, and the trolley off the wire. A wandering lead taken from some adjacent supply will enable the inspection to be carried out comfortably without the risk of a shock, and the still graver risk of the possible fall from the machine which may follow.

General.—The telphers should, as far as possible, be kept free from dirt and wet, and should be thoroughly cleaned-down once a week at least. All the working parts should be carefully and frequently cleaned, examined, and oiled; special care being taken to see that all the small pins, joints, &c., in connection with both the hand and foot brakes are all quite free and in working order. The "Stauffer" lubricators on the drum-hoist bearings, the intermediate hoist gear bearings, as well as the bearings of all the travelling wheels should be kept well charged with good quality lubricating grease, and a turn given to each periodically, to ensure that the bearings are well supplied with the lubricant.

Brakes.—Before commencing to work, the track brake, which operates on the travelling wheels on the main frame of the telpher, should always be seen to be in working order, and so adjusted that a small movement of the pedal in the driver's cabin ensures the brake being hard on. Should the wood blocks fitted in the cast-iron brake shoes become worn, they should be renewed. The best wood for this purpose is either hornbeam or willow. The solenoid hoisting brake is a rather difficult brake to set; and it is proposed to devote a rather lengthy description of this operation later in this section of the article.

Care of the Ropes.—The ropes should be examined at regular intervals, and a record kept of their condition. The ropes are worked under severe conditions, especially in gas-works where hot coke is dealt with by the telphers, and care must be taken to ensure their longest safe life and to prevent accident. It is advisable to cut off about 18 inches from the end of each rope next to the skip as often as appears necessary—say, every month. This removes the portion of the rope having the heaviest duty and the greatest exposure.

It is also advisable to periodically reverse the ropes—that is, the end fixed to the barrel, which is, of course, unworn, should be detached and fastened to the lifting bale, and *vice versâ*. Special anchor plates and clamping bolts are provided to facilitate the regular removal of the worn end. Special care should be taken to see that these plates are properly tightened-up, and a safety lashing or stop put on the free end of the rope to guard against faulty clamping. The ropes should be kept well lubricated with a grease free from all trace of acid. It must be borne in mind that the wear and tear on the ropes is very heavy; and unless these precautions are taken, it is impossible to get the full life out of them.

Setting the Brake.

Foremost among the adjustments which largely contribute to the satisfactory operation of the machine comes the proper setting of the brake—a rather delicate job, calling for a certain amount of intelligence and skill; and discrimination should be exercised

in the choice of the man detailed for this work. The main purpose of the brake is to hold the grab in case of any failure of current while the hoisting motion is in operation—a function which it performs quite independently of the lever-operated brake on the main brake drum. A loosely set brake may allow the load to fall some distance before the driver can get his hand brake into operation; while, on the other hand, a brake which does not properly leave the drum causes the motor to heat, due to increased current consumption, with an accompanying reduction in the economy of the machine, and will, in all probability, lead to a hot bearing at the brake end of the motor, due to mechanical friction. The writer proposes to give a detailed description of the manner in which this brake should be set.

The brake is of the solenoid type, and is so constructed that the passage of current through the motor, with which the brake winding is connected in series, releases the brake drum in the following manner (fig. 9). The outer end of the solenoid engages with a fork in the top of the lever A, which, in common with the trigger B, works on a fulcrum pin C, passing through the outer end of the upper brake block casting. The lever follows the solenoid on its inward stroke, and has cast upon it a step D, which, coming into contact with the adjusting screw E in the trigger, imparts a downward motion to the trigger. The trigger will now give a downward motion to the lower brake block casting (on the extremity of which it rests); and this, moving about the back fulcrum pin I, leaves the drum and comes to a rest when it meets the adjusting screw F. The lower brake casting having completed its stroke, which is limited by the screw F, the top brake casting now commences to lift, until, at the end of the plunger's stroke, both top and bottom brake blocks are quite clear of the drum.

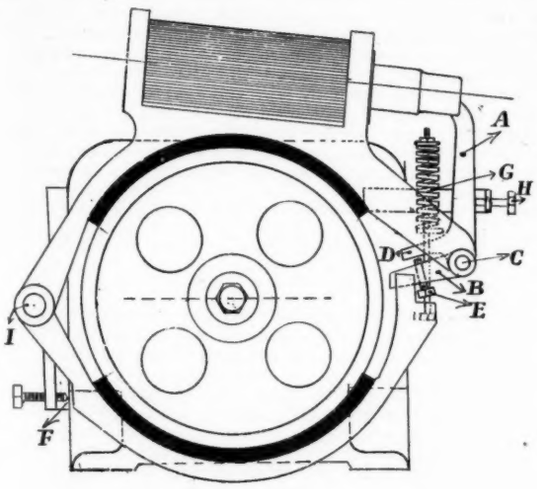


Fig. 9.

Before passing to the setting of the brake, it may be pointed out that the plunger should every fortnight be withdrawn, cleaned, lubricated, the solenoid cleaned, and the plunger replaced. A certain amount of coal dust, &c., is bound to be carried forward with the plunger; and this, unless it is periodically removed, will eventually "bind" the brake. The plunger may be lubricated with vaseline; but under no condition should oil be applied to the brake blocks—a practice which is far from uncommon, and cannot be too strongly condemned. If excessive heating or firing is taking place, it is due to the setting of the brake; and the application of oil to the blocks can only make matters worse.

The top and bottom castings having been set in position as described, the adjusting screw F should be set forward until the bottom brake block is just clear of the drum. The compression spring G must now be put in position and slight tension exerted, which will have the effect of applying both the top and bottom blocks to the drum. The adjusting screw E, in the trigger B, must next be screwed forward until its point is about $\frac{1}{8}$ inch away from the step D. The position of the step D may be regulated by means of the screw H, which governs the travel of the solenoid. With new blocks, however, this screw should be so set that, with the point of the screw E just projecting through the trigger B, the distance of $\frac{1}{8}$ inch mentioned above is maintained.

The required braking effect may now be attained by regulating the tension of the spring G by means of the tension nuts on the top of the bolt passing through the spring and connecting the top and bottom halves of the brake. All adjusting nuts should be securely locked; and if the blocks are new, the adjustment should for a week or so be followed up daily, until the blocks have bedded themselves to the drum.

Fig. 9 shows a solenoid brake mounted in the regular way—namely, with the solenoid coil on top—on a Siemens "C" type motor. It must be remembered, however, that in the case of a telpher hoisting motor the brake is inverted in the manner shown in fig. 10. In this photograph it will be observed that a separate brake lever and trigger are shown to the right of the illustration; and a study of these two parts, in conjunction with the particulars already given of this brake, will make its action more clear. This method of mounting the brake in an inverted position led, on the plant with which the writer is associated, to a rather awkward mishap.

Referring to fig. 10, it will be seen that the first motion of the brake brings the lower half of the band in contact with the stop F—thus limiting its downward motion; and when this lower portion carries the weight of the solenoid coil, as is the case with a

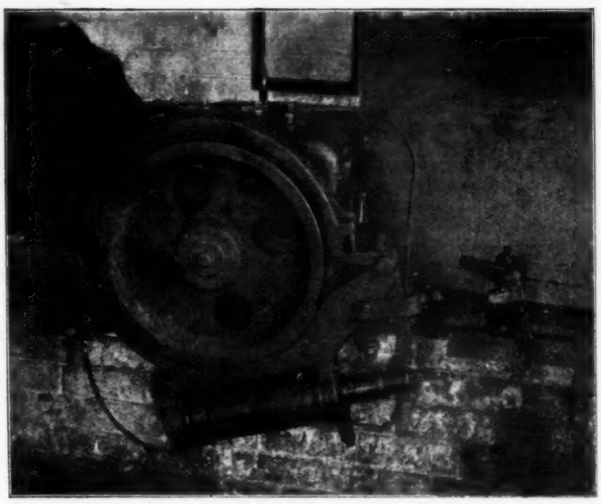


Fig. 10.

telpher brake, there is a bending strain set up at this point. In the case alluded to, the strain caused a fracture in the band casting. To obviate the possibility of a recurrence of this breakage, a gun-metal bracket, fitted with an adjusting screw, was bolted on the cross channel bearing that end of the motor in such a position that the point of the adjusting screw met the part of the brake fitment marked A in the photograph at the moment the lower element was clear of the drum.

The foregoing notes should enable the user of telphers fitted with this type of brake to obtain the maximum amount of efficiency and safety; but it may be remarked that Messrs. Strachan and Henshaw now supply their machines fitted with a brake of their own design.

(To be concluded.)

Sir William H. Lindley.

Several of the English papers last week published a report headed "A Confirmed Englishman," giving a translation of a telegram from Amsterdam in regard to Sir William H. Lindley. In reproducing the telegram, it may be mentioned that this is merely a revival of a statement which was given in the "JOURNAL" as far back as Nov. 17 last, p. 350. The Central News telegram was as follows:—

> The "Kölnische Zeitung" learns that Sir William H. Lindley has been appointed Doctor *honoris causa* of the Darmstadt University. Sir William Lindley is a British subject in the service of the Darmstadt Municipality, and has not been naturalized in Germany. He left Germany for Denmark after the outbreak of the war. The "Kölnische Zeitung" calls him a "confirmed Englishman," and is very indignant that the degree has been conferred upon him.—*Central News.*

Gas Supply in Paris Last Year.—According to the report of the Directors of the Paris Gas Company for the year ended Dec. 31, 1914, the revenue from the supply of gas was 77,030,112 frs.; while the sale of residuals, &c., produced 21,703,230 frs.—showing a total of 98,733,342 frs. (£3,949,334). The expenses for the same period came to 94,556,211 frs. (£3,782,249); leaving 4,177,131 frs. (£167,085) to be handed over to the Municipality of Paris, in accordance with the terms of the concession. The net profit derived by the City from the gas undertaking in the year 1912 was 23,460,816 frs. (£938,433), and in the following year 21,454,266 frs. (£858,170). The year 1914 was an exceptional one owing to the war. Had it not been for this terrible calamity, the profit accruing to the City would, the Directors estimate, have been about 18,750,000 frs. (£750,000). Owing to the disturbed conditions of affairs, the accounts included in the report furnish statistics connected with the supply of gas in the city for the first half of the past year only, and they are compared with the corresponding period of 1913. There was in the six months an increase of 2·2 per cent. in the quantity of gas sold; but on the entire year there was a decrease of 14 per cent. As the consumption fell off considerably after the month of August, the extra cost of coal for the year amounted to only 1,700,000 frs. (£68,000). The Directors' report, as usual, goes very fully into the Company's affairs; and some further particulars from it may be given in a future issue.

PROFESSOR WILLIAM A. BONE'S BRITISH ASSOCIATION ADDRESS.

President of Section B (Chemistry).

AN outstanding feature of last Wednesday's proceedings of the British Association at Manchester was the delivery of his Presidential Address to Section B (Chemistry) by Professor William A. Bone, D.Sc., F.R.S., of the Imperial College of Science and Technology, London. He began by asking the indulgence of the members, on account of the extremely short time which was given him to prepare himself for the onerous position which he was asked to fill in the emergency caused by Professor H. B. Baker's inability to preside, owing to his absence in Flanders. All he could, in the circumstances, he added, offer was a review, hastily put together, of recent progress in those branches of chemical science and technological practice in which his own particular work and experience lay. It would necessarily be incomplete, because there had been no time for the careful perusal of some recent memoirs which otherwise he would certainly have wished to refer to. But he would hope to find opportunity of remedying such defects—whether of omission, or of misinterpretation, or of wrong perspective—when revising the address before it finally appeared in the "Annual Reports."

GASEOUS COMBUSTION.

This year is, as many of you are doubtless aware, the centenary of Davy's invention of the miner's safety lamp, which formed the starting-point of his brilliant researches upon flame, in which he disclosed, and brought within the range of experimental inquiry, most of the intricate and baffling problems connected with the fascinating subject of gaseous combustion. Also the ground on which we meet to-day is known to the whole scientific world as the place where, during more than a quarter-of-a-century of continuous investigation, a succession of Manchester chemists, led and inspired by Professor H. B. Dixon, have devoted themselves to the elucidation of the many problems which Davy's work foreshadowed. Therefore, both in point of time and place, the occasion is singularly appropriate for a review of recent advances in this important field of scientific inquiry.

At the Sheffield meeting of the Association in 1910, I had the honour of presenting to a joint conference of Sections A and B (Physics and Chemistry) a report summarizing the then "State of Science in Gaseous Combustion,"* which gave rise to a keen and stimulating discussion, and was not only printed *in extenso* in the annual reports for that year, but was also widely circulated through the medium of the Scientific and Technical Press. There is no need, therefore, for me to refer in any detail to the results of researches already dealt with in that report. I can more usefully devote part of the time at my disposal to supplementing it with a review of more recent researches, which have considerably extended our knowledge in many directions.

IGNITION PHENOMENA.

The first section of my 1910 report was concerned with ignition temperatures and the initial phases of gaseous explosions; and it is in connection with ignition phenomena that subsequent progress has been most marked.

For the ignition of a given explosive mixture, it is necessary that the temperature of its constituents should be raised, at least locally, to a degree at which a mass of gas self-heats itself by combination until it bursts into flame, or, in other words, to a degree at which the chemical action becomes autogenous or self-propelling, so that it quickly spreads throughout the whole mass. This particular degree, or in some cases range, of temperature is commonly spoken of as the ignition-point of the mixture; but in using the expression, certain qualifications should be carefully borne in mind. In the first place, as H. B. Dixon and H. F. Coward showed in 1909,† whereas when certain combustible gases —such, for example, as hydrogen and carbon monoxide, the mechanism of whose combustion is probably of a fairly simple character—and air or oxygen are separately heated in a suitable enclosure before being allowed to mix, the temperature at which ignition occurs lies within a very narrow range, which is, within the limits of experimental error, the same for both air and oxygen [*i.e.*, in the case of hydrogen it is 580° to 590°, and for carbon monoxide 640° to 658°]. On the other hand, in cases where the mechanism of combustion is known to be very complex [*i.e.*, hydrocarbons], the ignition range is either fairly wide or else is materially lower in oxygen than in air (or both). Thus—

	In Air.		In Oxygen.
Methane.	650°–750°	..	556°–700°

The explanation of such behaviour is probably to be sought in the known complexity of the combustion, and the marked tendency for appreciable and fairly rapid interaction between the inflammable gas and oxygen before the actual ignition-point is reached. If, by any means, such preliminary interaction could either be entirely suppressed, or if, on the other hand, it be very rapid in character, the observed "ignition range" would be narrowed, as is actually the case with ethylene [542° to 547° in air, and 500° to 519° in oxygen].

There are two other means by which an explosive mixture may be ignited. One is by adiabatic compression; and the other, and most commonly employed of all, is by the passage of an electric spark. The adiabatic compression of an explosive mixture was originally suggested by Nernst as a means of determining its ignition-point, provided (1) ignition is not produced locally, while the main temperature of the gas is still far below the true ignition temperature, (2) the piston of the apparatus does not move appreciably after the gas has been raised to its ignition-point. At the time of my 1910 report, Falk, in America, had applied the method in the case of hydrogen and oxygen mixtures, with results which, in the light of more recent work, would appear to have been misleading or erroneously interpreted. Thus, for instance, he found that of all the mixtures of hydrogen and oxygen, the equimolecular $H_2 + O_2$ mixture has the lowest ignition temperature (514°), from which he concluded that the gases react initially to produce hydrogen peroxide rather than steam. Such a conclusion, which I believe to be erroneous, naturally directed attention to the experimental method involved.

The subject was promptly taken up here, in Manchester, by H. B. Dixon and his co-workers,* with the result that much new light has been thrown on the phenomena accompanying ignition. The ratio of the ignition temperature to the initial temperature of the mixture before compression, both expressed in degrees absolute, $\left(\frac{T_2}{T_1}\right)$, may be calculated from the compression ratio, $\left(\frac{V_1}{V_2}\right)$, by means of the well-known formula for adiabatic compression:

$$\frac{T_2}{T_1} = \left(\frac{V_1}{V_2}\right)^{\gamma - 1}$$

where γ = the ratio of the specific heats at constant pressure and volume, respectively, of the mixture compressed, and which for a mixture of diatomic gases, such as hydrogen and oxygen, is usually taken as 1·40.

Dixon's recent photographic analysis of the appearance of flame when mixtures of carbon bisulphide and oxygen ($CS_2 + 3O_2$) are adiabetically compressed, have proved that the flame, starting from a point or layer, always takes an appreciable time to spread through the mixture, and that unless special precautions are taken to arrest the piston at the moment of its attainment of the ignition condition, it may be driven in much further than the minimum distance for ignition. The real ignition-point, as above defined, is not necessarily synchronous with the actual appearance of the flame. There may be, and usually is, an appreciable "pre-flame" period. Only in the fastest-burning mixtures is this period negligible; hence the necessity of artificially stopping the movement of the piston at the beginning of the period—a precaution which Falk seems to have neglected.

According to Dixon and Croft's recent determination by this method of the ignition-points of mixtures containing electrolytic gas, whereas successive additions of hydrogen or nitrogen progressively raise the ignition temperature of the undiluted gas by regular increments, as would be supposed, successive additions of oxygen, on the other hand, lower it, as a glance at the following table will show:

Ignition Points of Mixtures Containing Electrolytic Gas by Adiabatic Compression.

[H. B. Dixon and J. M. Crofts, 1914.]

Electrolytic Gas, $2H_2 + O_2 = 526°$.

+ x H_2.		+ x N_2.		+ x O_2.	
x = 1 . .	544°	x = 1 . .	537°	x = 1 .	511°
x = 2 . .	561°	x = 2 . .	549°	x = 7 .	478°
x = 4 . .	602°	x = 4 . .	571°	x = 15 .	472°
x = 8 . .	676°	x = 8 . .	615°		
(526 + 18 x)°		(526 + 11 x)°			

The observed raising effects of successive dilutions with hydrogen and nitrogen call for no comment, save that the relatively greater effect of hydrogen as compared with nitrogen may be attributed to its greater thermal conductivity; but the lowering effect of oxygen is indeed puzzling, and its meaning can only be conjectured. Dixon and Crofts have suggested that it may be due either to the formation of some active polymeride of oxygen under

* See "JOURNAL," Vol. CXI., p. 648. † *Ibid.* Vol. CVII., p. 323.

* H. B. Dixon, L. Bradshaw, and C. Campbell, "Trans. Chem. Soc.," 1914, 105, 2027; H. B. Dixon and J. M. Crofts, *ibid*, p. 2036.

the experimental conditions, which seems to me doubtful, or that the concentration of oxygen in some way or other brings about increased ionization of the combustible gas. This at once raises the larger question of whether or not ignition is a purely thermal problem, as until recently has generally been supposed.

Professor W. M. Thornton, of Newcastle-upon-Tyne, recently published some very suggestive work on the "Electrical Ignition of Gaseous Mixtures,"* which, apart from its theoretical interest, has an important bearing on the safety of coal-mines where electrical currents are used for signalling and other purposes.

The common belief that any visible spark will ignite a given explosive mixture of gas and air is, of course, quite erroneous; for just as Coward and his co-workers have shown that for a given explosive mixture and sparking arrangement there is a certain limiting pressure of the gaseous mixture below which ignition will not take place, so from Thornton's work it would appear that a definite minimum of circuit energy is required before a given mixture at given pressure can be ignited by a spark. And, moreover, he has stated that the circuit energy required for the spark ignition of a given mixture (say) of methane and air is something like 56 times greater with alternating than with continuous current at the same voltage. From this he has argued that the igniting effect cannot be simply thermal, but must be in part at least ionic. This conclusion he further supports with the statement that the igniting power of a unidirectional current is proportional to the current in the case of many gaseous mixtures over an important part of their working range of inflammability.

While there is much that is suggestive in Thornton's work, there is also a good deal which seems very difficult to interpret from a chemical standpoint. I here refer more particularly to his later supposition of "stepped ignition," which is based upon certain observed abrupt increases in the minimum igniting current required with condenser discharge sparks as the proportion of combustible gas in the air mixture examined progressively increases. In other words, it is claimed that continuous alteration of the proportions of gas and air in an explosive mixture is, or may be, accompanied by discontinuous alterations in the spark energy required for ignition. I must confess that, after careful examination of the published curves, I am quite at a loss to give them any chemical interpretation, and to being somewhat sceptical about the supposed "stepped ignition." A repetition and extension of Professor Thornton's experiments would be most valuable as a means to a better understanding of the conditions of spark ignition.

INFLUENCE OF ELECTRONS UPON COMBUSTION.

During the discussion upon my 1910 report, Sir J. J. Thomson reminded us chemists that combustion is concerned, not only with atoms and molecules, but also with electrons moving with very high velocities. They might be a fact of prime importance in such intensive forms of gaseous combustion as are realized in contact with hot or incandescent surfaces, as also in the explosion wave. It is well known, of course, that incandescent surfaces emit enormous streams of electrons travelling with high velocities; and the actions of such surfaces may be due to the formation of layers of electrified gas in which chemical changes proceed with extraordinarily high velocities. Again, the rapidity of combustion in the explosion wave might, he thought, conceivably be due to the molecules in the act of combining sending out electrons with exceedingly high velocities, which precede the explosion wave and prepare the way for it by ionizing the gas.

With regard to this interpretation of the action of surfaces, Mr. Harold Hartley carried out a promising series of experiments in my laboratory at Leeds University upon the combination of hydrogen and oxygen in contact with a gold surface, which lend some support to the idea. But they require further extension before it can be considered as finally proved. It is my intention in the near future to resume the systematic investigation of the matter as rapidly as circumstances permit; but the experimental difficulties are formidable, and the mere chemist working by himself may easily be misled. We badly need the active co-operation of physicists in elucidating the supposed role of electrons in combustion.

Professor H. B. Dixon and his pupils have, at Sir J. J. Thomson's suggestion, recently tested the idea as applied to the explosion wave, with, however, negative results.† It is known, of course, that the motion of the ions can be stopped at once by means of a transverse magnetic field, in which they curl up, and are caused to revolve in small circles; and the question which Professor Dixon decided to put to the test of experiment was whether the damping of the electronic velocities in a powerful magnetic field would have any appreciable effect either upon the initial phase of an explosion or upon the high velocity of detonation. But though he employed a very intense magnetic field produced by some powerful magnets specially constructed by Sir Ernest Rutherford for the deflection of electrons of high velocity, no appreciable effect was observed upon the character or velocity of the flame with any gas mixture at any stage of the explosion. And inasmuch as the high constant velocity of the explosion wave can be entirely accounted for on the theory of a compression wave liberating the chemical energy as it passes through the gases, there seem as yet to be no experimental grounds for attributing it to the ionizing action of electrons.

* "Proc. Roy. Soc.," A., Vol. 90, 1914, p. 272; Vol. 91, 1914, p. 17.

† "Proc. Roy. Soc.," 1914, Section A., Vol. 90, p. 506.

THE INITIAL PERIOD OF "UNIFORM MOVEMENT" OR "INFLAMMATION" OF FLAME THROUGH INFLAMMABLE MIXTURES, AND LIMITS OF INFLAMMABILITY.

Mallard and Le Chatelier, in their classical researches upon the combustion of explosive mixtures, discovered that the propagation of flame, when such a mixture is ignited in a horizontal tube, differs according as whether the ignition occurs near the open or closed end of the tube. In the first case, the flame proceeded for some distance down the tube at a practically uniform and fairly slow velocity, corresponding to the true rate of propagation "by conduction." This period of uniform movement is succeeded by an irregular oscillatory period, in which the flame swings backwards and forwards with increasing amplitudes—finally either dying out altogether or else giving rise to detonation. With certain oxygen mixtures, the initial period of uniform slow velocity was shorter, and appeared to be abruptly succeeded by detonation without the intervention of any oscillatory period. When, however, such mixtures were ignited near the closed end of a horizontal tube, the forward movement of the flame was continuously accelerated from the beginning, under the influence of reflected compression waves, until detonation was set up. Such, in general, was the sequence of the phenomena that were observed by these distinguished French investigators.

They proceeded to determine experimentally the velocities of the uniform slow movement of the flame in the case of a number of air and combustible gas mixtures, and plotting their results (in c.ms. per sec.) as ordinates against percentages of inflammable gas as abscissæ, they obtained "curves" which were in each case formed of two inclined straight lines converging upwards to a point which represented the composition and flame velocity of the most explosive mixture. And they concluded that the points at which the downward production of the two lines met the zero velocity line would define the upper and lower limits of inflammability for the particular series of gas-air mixtures. Thus the curve they obtain for methane-air mixtures was as fig. 1, showing a maximum velocity of 61 c.ms. per second for a mixture containing about 12·2 per cent. of methane, with lower and upper limits corresponding to 5·6 and 16·7 per cent. of methane respectively.

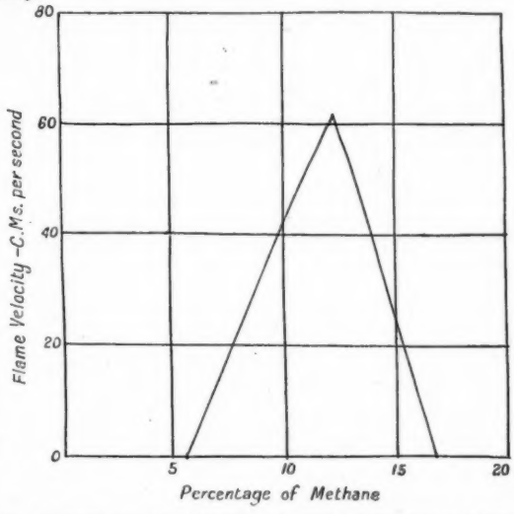


Fig. 1.—Mallard and Le Chatelier's Curve for Velocities of Inflammations on Methane-Air Mixtures.

An exact knowledge of the velocities of flame propagation during this initial period of uniform slow movement, as well as of the limits of inflammability for mixtures of various combustible gases and air, is very important from a practical point of view. Makers of apparatus for burning explosive mixtures of gas and air want to know the speed of flame propagation through such mixtures, not only at ordinary temperatures and pressures, but also when the mixtures are heated and used at higher pressures. Also, it would be important to know whether or not, in the case of a complex mixture of various combustible gases and air, when complete composition can be determined by analysis [as, for example, coal gas and air], the velocity of flame propagation can be calculated from the known velocities for its single components. Unfortunately, although more than thirty years have elapsed since Mallard and Le Chatelier's work was published, the necessary data are still wanting to answer such questions; and anyone who will systematically tackle the problem and carefully work it out in detail will be doing a real service to the gas-using industry. I am hoping shortly to make a beginning with such an investigation in my new department at the Imperial College, London; but the successful and rapid progress of such work will involve considerable financial outlay, as well as organization and expert direction. Who will help us with the necessary funds?

An accurate knowledge of the behaviour of methane-air mixtures under known variations of conditions is of prime importance from the point of view of the safety of coal mines; and it is

rightly occupying the attention of my friend and former collaborator, Dr. R. V. Wheeler, at the Home Office Experimental Station at Eskmeals. From papers which he has already published, as well as from some unpublished results which he has very kindly permitted me to refer to in this address, it is now possible to correct certain errors in Mallard and Le Chatelier's results, and to arrive at a clearer view of the phenomena as a whole.

In the first place, it would appear that the initial "uniform movement" of flame in a gaseous explosion, or, in other words, propagation of the flame from layer to layer by conduction only (as defined by Le Chatelier), is a limited phenomenon, and is only obtained in tubes of somewhat small diameter—wide enough, however, to prevent appreciable cooling of the flame, but narrow enough to suppress the influence of convection currents. Moreover, ignition must be either at or within one or two centimetres of the end of the tube; otherwise—particularly with the more rapidly moving flames—vibrations may be set up right from the beginning.

While all methane-air mixtures develop an initial uniform slow flame-movement period when ignited at, or near, the open end of a horizontal tube, both its linear duration as well as the flame velocity are not, according to private information which Dr. Wheeler has sent me, independent of the dimensions of the tube. The speed of flame increases with the diameter of the tube; and the linear duration of the uniform period increases with both the diameter and length of the tube up to a certain maximum, after which increased length probably makes no appreciable difference. Also, for the same tube, it varies with the proportion of methane in the explosive mixture—being greater as the speed of the flame diminishes, until with the two "limiting" explosive mixtures it appears to last almost indefinitely.

Dr. Wheeler's recent re-determination of the velocities of the flame movement during this initial uniform period for mixtures of methane and air in varying proportions within the limits of inflammability, has revealed serious erorrs in Mallard and Le Chatelier's original results for horizontal tubes of the same diameter as those which Dr. Wheeler has employed. Moreover, Mallard and Le Chatelier's method of determining the composition of the upper and lower limits of inflammability by extra polation from their curves has been proved to be unwarranted. Dr. Wheeler considers the length of the tubes used by Mallard and Le Chatelier (1 metre only) was insufficient to ensure that the speed measurements of the initial uniform flame-movement period were unaffected by the subsequent "vibratory period." Also, the methane used by them, prepared as it was from sodium acetate, would obviously be impure.

The most important differences between the latest results published by Dr. Wheeler and those originally determined by Mallard and Le Chatelier, as shown on the accompanying diagram (fig. 2), are as follows:—

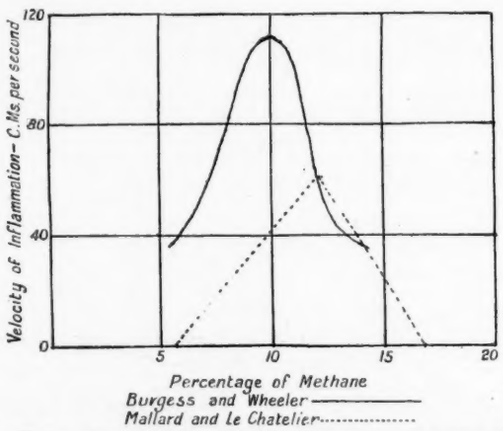


Fig. 2.—Burgess and Wheeler's and Mallard and Le Chatelier's Results Compared.

(1) According to Wheeler, the limits of inflammability for horizontal propagation of flame in methane-air mixtures, at atmospheric temperature and pressure, correspond to 5·4 and 14·3 per cent. methane content respectively; whereas Mallard and Le Chatelier gave 5·6 and 16·7 per cent.

(2) Whereas, according to Mallard and Le Chatelier, the flame velocities for mixtures near the upper and lower limits would gradually approximate to the zero velocity ordinate, as the limiting composition was approached, according to Wheeler the velocities for both the upper and lower limiting mixtures are considerable (in each case about 36 c.ms. per second; and there is an abrupt change from these velocities to zero velocity as the particular limiting composition is passed.

(3) Whereas Mallard and Le Chatelier found a maximum velocity of 63 c.ms. per second for a mixture containing about 12·2 per cent. of methane, and rapid falling off in velocity as this particular composition is deviated from, Wheeler finds a maximum velocity of 110 to 112 c.ms. per second for a series of mixtures containing from 9·45 to 10·55 per cent. of methane. Such differences as are thus disclosed only emphasize the need of a complete experimental revision of the subject.

Messrs. Burgess and Wheeler have recently determined the limits of inflammability of methane when mixed, at atmospheric temperature and pressure, with "atmospheres" of oxygen and nitrogen containing less oxygen than ordinary air. From their results [see below], it would appear that, as the oxygen content of the atmosphere is reduced, the limits of inflammability are narrowed until they coincide when the oxygen content falls below 13·3 per cent., which means that an atmosphere containing 13·3 or less per cent. of oxygen is truly extinctive for a methane flame at ordinary pressures.

Atmosphere.		Methane, per Cent.	
Oxygen.	Nitrogen.	Lower Limit.	Higher Limit.
20·90	79·10	5·60	14·82
17·00	83·00	5·80	10·55
15·82	84·18	5·83	8·96
14·86	85·14	6·15	8·36
13·90	86·10	6·35	7·26
13·45	86·55	6·50	6·70

BEHAVIOUR OF WEAK MIXTURES OF GASES AND AIR.

My review of this part of the subject would be incomplete without a reference to some interesting observations which have been made by Dr. H. F. Coward and co-workers at the Manchester School of Technology, upon the behaviour of weak mixtures of various inflammable gases and air, at or just below the lower limit of inflammability in each case.* Their principal experiments were carried out in a rectangular box of 30 c.m. square section and 1·8 metres length, with two opposite sides of wood, and the other two of plate glass. The box was placed in an upright position; the bottom being water-sealed and the top closed, with a suitable igniting device placed near the bottom. They have shown that caps or vortex rings of flame may be projected for some distance upwards from the source of ignition—sometimes apparently for an indefinite distance, without igniting the whole of the combustible mixture. In such mixtures there may be an indefinite upward slow propagation of flame, together with incompleteness of combustion [much of the combustible mixture remaining unburnt]; and the question very naturally arises as to how the term "inflammability" should be scientifically defined. Dr. Coward has argued, with some force, that a gaseous mixture should not be termed "inflammable" at a given temperature and pressure, unless it will propagate flame indefinitely—the unburnt portion being maintained at that temperature and pressure. Inflammability thus defined would be a function of the temperature, pressure, and composition of a particular mixture only, and would be independent of the shape and size of the containing vessel; and provided that it is kept in mind that for each particular mixture at a given temperature and pressure a certain minimum igniting energy and intensity is requisite, I am inclined to agree with the definition. Also, there is a possibility that in a mixture just at, or very near, one or other of the limits of inflammability, flame may be propagated upwards, but not downwards.

From his experiments, Dr. Coward has assigned the problems as the lower limits of inflammability of hydrogen, methane, and carbon monoxide respectively, in air at atmospheric temperature and pressure:

	Per Cent.
Hydrogen	4·1
Methane	5·3*a*
Carbon monoxide	12·6

a Too much stress need not be laid upon the difference between this number and the 5·6 per cent. given by Dr. Wheeler (*loc. cit*), because Dr. Coward himself admits that the flames of mixtures containing from 5·3 to 5·6 per cent. of methane are very sensitive to shock; while a 5·6 per cent. mixture will always propagate flame indefinitely, even when there is a moderate disturbance. The conditions must be exceedingly tranquil to prevent extinction in the other cases.

COMBUSTION OF HYDROCARBONS AND RELATIVE AFFINITIES OF METHANE, HYDROGEN, AND CARBON MONOXIDE RESPECTIVELY FOR OXYGEN IN FLAMES.

Under the title of "Gaseous Combustion at High Pressure," I have recently published, in conjunction with various collaborators,† a further instalment of my researches on the mechanism of hydrocarbon combustion;‡ and I may perhaps be allowed to draw your attention to certain new points which have arisen in connection therewith.

A detailed study of the behaviour of mixtures of methane and oxygen, of composition ranging between $2CH_4 + O_2$ and $CH_4 + O_2$, when exploded in steel bombs at initial pressures of 12·7 atmospheres [see the following table], has shown it to be consistent with the "hydroxylation" theory of hydrocarbon combustion which I put forward some years ago as the result of my previous work. The following scheme seems to interpret correctly the chemical and thermal changes involved in the initial stages of the explosive combustion of methane.

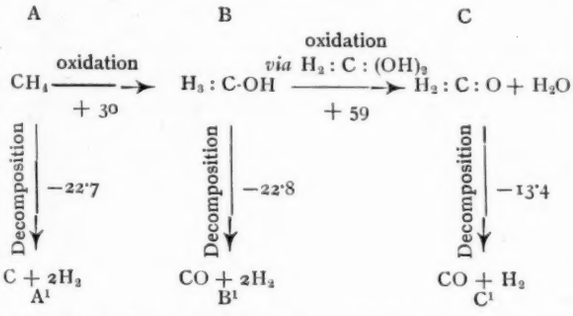
* "Trans. Chem. Soc.," 1914, Vol. 105, p. 1859.

† Messrs. Hamilton Davies, H. H. Gray, H. H. Henstock, and J. B. Dawson.

‡ Phil. Trans. Roy. Soc., "A.," Vol. 215 (1915), pp. 275 to 318.

Explosion of Mixtures of Varying Composition between $2CH_4 + O_2$ *and* $CH_4 + O_2$ *in Bomb "A" at Initial Pressure 12·7 Atmospheres.*

Experiment No.	10.		11.		12.		13.	
Pressures in atmospheres p_1	12·74		12·72		12·68		12·61	
Pressures in atmospheres p_2	15·05		18·10		17·30		14·10	
p_2/p_1	1·18		1·42		1·36		1·12	
Original mixture	Per Cent.	Partial Pressures, Atmospheres.	Per Cent.	Partial Pressures, Atmospheres.	Per Cent.	Partial Pressures, Atmospheres.	Per Cent.	Partial Pressures, Atmospheres.
CH_4	67·15	8·55	59·3	7·54	55·75	7·09	50·8	6·40
O_2	32·85	4·19	40 7	5·18	44·25	5·59	49·2	6·21
Gaseous products	Per Cent.	Partial Pressures, Atmospheres.	Per Cent.	Partial Pressures, Atmospheres.	Per Cent.	Partial Pressures, Atmospheres.	Per Cent.	Partial Pressures, Atmospheres.
CO_2	3·10	0·47	2·70	0·49	3·85	0·67	7·45	1·05
CO	25·40	3·83	35 60	6·44	37·25	6·44	38·50	5·44
CH_4	16·60	2·50	4·65	0·84	2·25	0·39	*Nil*	*Nil*
H_2	54·90	8·26	57·05	10·32	56·65	9·80	54·05	7·60
Units in original mixture	C. 8·55	H. 17·10	O. 4·19	C. 7·54	H. 15·08	O. 5·18	C. 7·09	H. 14·18	O. 5·59	C. 6·40	H. 12·80	O. 6·21
Units in gaseous products	6·80	13·26	2·38	7·77	12·00	3·71	7·50	10·58	3·89	6·49	7·60	3·77
Difference atmospheres	1·70	3·84	1 81	—	3·08	1·47	—	3·60	1·70	—	5·20	2 44
Difference per cent.	20		43 2			28·4			30·4			38·2
Ratio $\frac{CO \times OH_2}{CO_2 \times H_2}$ in products	3·65		3·75		3·43		3·4	
Remarks	Explosions almost inaudible; carbon deposited.		Explosion distinctly audible.		No carbon deposited.		Very violent explosion with sharp metallic click. No carbon deposited.	



The principal experimental facts which this—or, indeed, any alternative—scheme must explain are :

(1) That whenever mixtures of composition between $2CH_4 + O_2$ and $CH_4 + O_2$ are exploded under pressure, a considerable proportion of the original oxygen appears as steam in the products.

(2) That there is a marked minimum in the proportion of such oxygen as the composition of the original mixture approximates to $3CH_4 + 2O_2$.

(3) That there is a total cessation of any separation of carbon [which is very marked with mixtures $2CH_4 + O_2$] after the proportion of oxygen in the original mixture attains or exceeds the limit $3CH_4 + 2O_2$.

Now if, as I believe, the initial interaction of methane and oxygen is at all temperatures essentially a "hydroxylation" process, accompanied by the decomposition [more or less rapid according to the temperature] of the primarily formed hydroxylated molecules, a consideration of the chemical and thermal aspects of the process will point to certain possibilities which are, indeed, actually realized in fact.

In the first place, monohydroxymethane (methyl alcohol) $CH_3.OH$, is known to decompose at high temperature, yielding carbon monoxide and oxygen, without any separation of carbon or formation of steam, $CH_3.OH = CO + 2H_2$. Also, the very unstable dihydroxymethane, $H_2 : C : (OH)_2$, would yield formaldehyde and steam, $H_2 : C(OH)_2 = H_2 : C : O + H_2O$; and the formaldehyde would in turn decompose into carbon monoxide and hydrogen, $H_2 : C : O := CO + H_2$, without any deposition of carbon whatever.

If now the thermal consequences of such facts be considered, it would appear (1) that the oxidation of methane to $H_3 : C.OH$ [A to B in the scheme] were accompanied by thermal decomposition at this stage (B to B^1), the net heat evolution would be $(30 - 22·8) = 7·2$ kilogram Centigrade units; whereas (2) of the same amount of oxygen reacted in such a way that there was a "non-stop" run through the monohydroxy to the dihydroxy stage, with decomposition at the point [A to C and C to C^1], the corresponding net heat evolution would be $\frac{1}{2}(30 + 59 - 13·4) = 37·8$ units, or about five times as much as in (1). Hence, there would always be a strong tendency for such a non-stop run from A to C through B, without any decomposition occurring at B; and such would always occur whenever the oxygen present in the original mixture attained the equi-molecular proportion $CH_4 + O_2$.

Again, if the original mixture contained only one-half such proportion of oxygen ($2CH_4 + O_2$), there would still be a decided preference for an oxidation of half of the methane by a non-stop run A to C through B, rather than an oxidation of the whole of the methane to B only—the other half of the methane remaining unchanged, or undergoing thermal decomposition into its elements, $CH_4 = C + 2H_2$ (A to A^1). Also the latter process would use up no more of the energy developed from the oxidation than would be required for the decomposition of a corresponding quantity of $H_3 : C.OH$ at stage B (B to B^1). Hence, when such a mixture $2CH_4 + O_2$ is exploded under pressure, the formation of carbon and its oxides, hydrogen, and considerable quantities of steam may be expected, which is precisely what actually occurs.

When, however, the proportion of oxygen in the original mixture reaches the limit $3CH_4 + 2O_2$, while it is still insufficient to oxidize the whole of the hydrocarbon to the dihydroxy stage, there is enough of it to prevent any methane remaining unoxidized to (at least) the monohydroxy stage; and therefore, seeing that the affinity of methane for oxygen far exceeds those of either hydrogen or carbon monoxide, it is to be expected that no substantial proportion of the original methane would escape oxidation to either the mono- or the di- hydroxy stage. But inasmuch as not more than about one-third of the original methane could, in the circumstances, be transformed into the dihydroxy stage, it follows that a considerable amount of thermal decomposition at the monohydroxy stage would occur.

If this view is correct, it follows that there should be an entire suppression of carbon deposition at or about the $3CH_4 + 2O_2$ ratio; and, also, that with this particular mixture a smaller proportion of the original oxygen should appear as steam in the products than would be the case with either the $2CH_4 + O_2$ or the $CH_4 + O_2$ mixture, which, again, is precisely what we find.

In considering the question of the explosive combustion of hydrocarbon, it is important to distinguish between (1) the primary oxidation of the hydrocarbon, which is an exceedingly rapid process, and is probably completed during the short interval between ignition and the attainment of maximum pressure, and (2) certain probable secondary interactions where influence may extend far into the subsequent cooling period; for it is only this latter which would be affected by variations in the rate of cooling down from the maximum temperature. Such secondary interaction may include the reversible change $CO + OH_2 = CO_2 + H_2$, and, in cases where carbon is deposited as the result of the decomposition of primary oxidation products, the interaction of steam and carbon $C + OH_2 = CO + H_2$. In this connection, I may draw attention to the recently published work of G. W. Andrew,* one of my former pupils and collaborators, on the "Water-Gas Equilibrium in Hydrocarbon Flames," which proves that, in a system containing only CO_2, CO, H_2, H_2O, rapidly cooling down from the high temperatures prevailing in hydrocarbon flames, the equilibrium ratio $\frac{CO \times OH_2}{CO_2 \times H_2}$ adjusts itself automatically with the temperature until a point between 1500° and 1600° C. on the cooling curve is reached [corresponding to a value $K = 4·0$ approximately], after which no further readjustment occurs. He also found that this adjustment of equilibrium is not greatly influenced, even when relatively large quantities of methane and carbon are found in the final products.

I am able, from my own experiments, to confirm Andrew's conclusions in all cases where the initial firing pressure is insufficient to set up detonation. But in cases where both detonation and separation of carbon occur, my results undoubtedly indicate an

* "Trans. Chem. Soc.," 1914, Vol. 105, pp. 444-456.

appreciable intervention of the separated carbon during the cooling period. There is nothing in my results, however, suggestive of an appreciable intervention of methane.

The fact that the primary oxidation of methane usually involves a direct transition from $CH_4 + O_2$ to $CH_2(OH)_2$, which latter breaks up into, ultimately, $CO + H_2 + H_2O$, without deposition of carbon, opened up the possibility of instituting a direct experimental comparison between the relative affinities of methane and hydrogen for oxygen in explosion, by exploding a series of mixtures $CH_4 + O_2 + xH_2$ in which the hydrocarbon and oxygen were initially present in as nearly as possible equi-molecular proportions, but in which x [the volume ratio of H_2 to CH_4] was varied between 2 and 8, and determining (1) the oxygen distribution on explosion when $x=2$, and (2) the influence upon such distribution of successive equal increments of x up to 8.

Ever since Davy's experiments in flame, the combustibility of hydrogen has been erroneously considered to be superior to that of methane; but, on the other hand, my previous researches upon hydrocarbon combustion have shown (1) that in slow combustion in borosilicate glass bulbs at temperatures between 300° and 400° C., methane, ethane, and acetylene are all oxidized at a much faster rate than in hydrogen or carbon monoxide, and also (2) that, in exploding such mixtures as $C_2H_4 + H_2 + O_2$ or $C_2H_2 + 2H_2 + O_2$, the hydrocarbon is burnt in preference to hydrogen—facts which are at variance with any notion of the superior affinity of hydrogen for oxygen in flames.

My further experiments upon the relative affinities of methane and hydrogen for oxygen in explosives were carried out at high initial pressures in two special steel bombs—namely, A, with a cylindrical explosion chamber, 8 inches long and 1 inch in diameter [capacity = *circa* 103 c.c.]; and, B, with a spherical cavity 3 inches in diameter [capacity = *circa* 275 c.c.]. The ratio of wall surface of the explosion chamber in the case of bomb A would thus be about 2·75 times that of bomb B. The mean results for the distribution of oxygen between methane and hydrogen in the two sets of experiments were as in the next table.

It is at once quite evident, from the results with the mixture $CH_4 + O_2 + 2H_2$, that the affinity of methane is at least twenty to thirty times greater than that of hydrogen for oxygen in explosion flames. The actual distribution of oxygen when a particular mixture is exploded, is undoubtedly influenced to some extent by the walls of the containing vessel, but not, so far as I have been able to ascertain, by the absolute initial pressure. Moreover, it is evident that the influences of successive increases in x, the volume ratio of H_2 to CH_4 in the mixture exploded, upon the actual oxygen distribution for a given explosion, is proportionate to x^2, which can hardly mean other than that in explosion flames hydrogen is directly burnt to steam, and not, as many have supposed, *viâ* the intermediate formation of hydrogen peroxide.

Oxygen Distribution if Mixtures $CH_4 + O_2 + x$H *are Exploded.*

x		2	4	6	8
		Per Cent.	Per Cent.	Per Cent.	Per Cent.
Bomb A	O_2 to CH_4	95·34	81·0	54·9	31·4
	O_2 to H_2	4·66	19·0	45·1	68·6
Bomb B	O_2 to CH_4	97·1	91·0	72·6	—
	O_2 to H_2	2·9	9·0	27·4	—

A similar series of experiments with mixtures $CH_4 + O_2 + x$CO show that, while it is impossible, owing to circumstances which I need not here detail, to deduce, even approximately, any numerical relation between the affinities of methane and carbon monoxide for oxygen in flames, yet we can confidently say that the affinity of the hydrocarbon is again vastly the superior, although carbon monoxide is apparently more effective than hydrogen in pulling away oxygen from the predominating attraction of methane.

Having thus satisfactorily disposed of the question of the relative affinities of the three gases for oxygen in explosion flames, it remained to prove whether or not such chemical factors determine the ratio of attainment of maximum pressure in explosives, by exploding mixtures of each of the three combustible gases with air, in such proportions as correspond with the primary oxidation —namely, (1) $CH_4 + O_2 + 4N_2$, (2) $2H_2 + O_2 + 4N_2$, and (3) $2CO + O_2 + 4N_2$—at initial pressures of 45 to 50 atmospheres in the spherical bomb B, to which was attached a Petavel recording manometer with its optical accessories.

The pressure records which are reproduced in the following diagrams (figs. 3, 4, and 5) in which pressures in atmospheres are

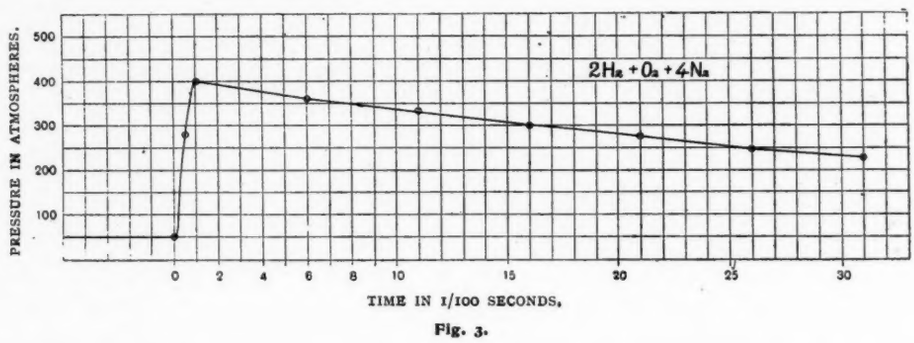


Fig. 3.

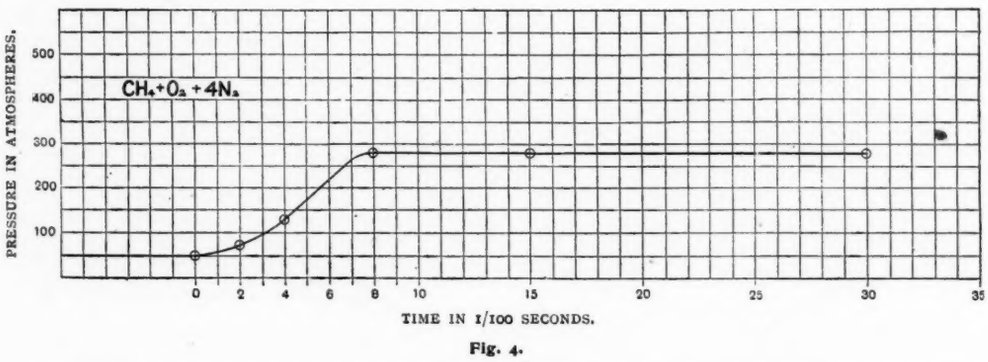


Fig. 4.

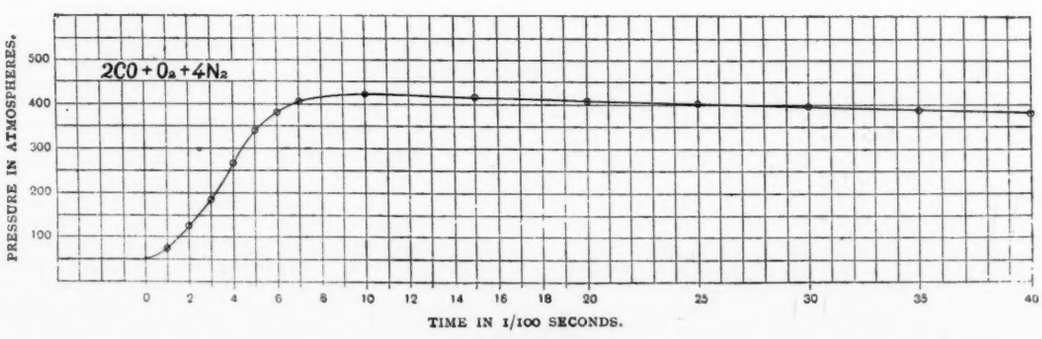


Fig. 5.

plotted against time in seconds, prove conclusively the absence of any direct relation between the actual rate at which the potential energy of an explosive mixture is transferred on explosion as sensible heat to its products, and the magnitude of the chemical affinity between its combining constituents. This is hardly to be wondered at, seeing the extreme rapidity of chemical interaction at high temperature as compared with the rate at which the liberated heat be communicated to, and uniformly distributed among, the products by ordinary physical processes. Attention may be drawn to the extreme slowness of the cooling in each case after the attainment of maximum pressure. This has also been observed by previous workers in other similar cases of gaseous explosions. This was particularly marked in the case of the methane-air mixture, in which there was hardly any appreciable cooling during an interval of 0·22 seconds after the attainment of maximum pressure [in 0·08 second],.a circumstance which may be due in part to the combustion taking place in well-defined chemical stages, and in part also to the operation of the exothermic secondary interaction between carbon monoxide and steam during the cooling period. On the other hand, the curve for the hydrogen-air mixture, where the combustion to steam is a direct and comparatively simple transaction, suggests that the attainment of maximum pressure is succeeded by a period of gradual cooling uninfluenced by chemical combination.

FUEL ECONOMY AND THE PROPER UTILIZATION OF COAL.

Leaving now the scientific aspects of flame and combustion, I wish to say a few words as a technologist upon the great national importance of a more adequate scientific control of fuel consumption and the utilization of coal generally, with special reference to the situation created by this terrible and ruinous European conflict. And my remarks will be addressed in part to my chemical friends and colleagues, who are primarily interested in scientific research and its industrial applications, and in part also to the commercial and manufacturing community which is chiefly interested in the financial results of such scientific activity.

Notwithstanding the fact that we are raising annually in the United Kingdom—according to the official estimate for 1913—287 million tons of coal, of which 189 million tons (or, say, 4 tons per head of the population) were consumed at home, more or less wastefully, it is indeed surprising how little has been done, or is being done, by the scientific community to impress upon the Government and the public generally, the importance of establishing some systematic control or investigation of fuel consumptions in all large industrial areas. Deputations have waited upon the Government about the question of reviving our languishing coal-tar colour industry; so that in future we may be independent of Germany for the supply of the £2,000,000 of dye-stuffs required by our textile industries; and already a State-aided organization, with an Advisory Scientific Committee, has sprung into existence to achieve this desirable result. But no organized body of scientific men, so far as I know, has ever thought it important, or worth while, to take an active interest in the vastly greater subject of fuel economy and the proper utilization of coal, upon which the dyeing industry depends for its raw material.

It is unnecessary for me to remind you that the contending armies in this Armageddon of the nations depend upon certain distillation products of coal for their supplies of high explosives; and there is little doubt in my mind but that Germany's violation of the neutrality of Belgium, and her subsequent seizure of that country and of a large tract of Northern France, had more than a purely political or strategic significance. She, doubtless, wanted also to seize for herself (and at the same time to deprive her enemies of) coalfields lying just beyond her own borders, which are capable of furnishing abundant supplies of coal admirably adapted for yielding the raw materials for the manufacture of high explosives. A country in which all metallurgical coke has for years past been manufactured under chemical supervision in bye-product coking-ovens, with recovery of ammonia, tar, and benzol, and in which the wasteful beehive coking ovens have long ago ceased to exist, was hardly likely to overlook the military importance of the Belgian coalfield with its many bye-product coking plants. And, moreover, but for German commercial acumen and enterprise, during many years past, our own bye-product industry would not have attained even to its present respectable dimensions. Certainly it owes very little to the interest or attentions of British chemists, most of whom are, unfortunately, but little aware of its circumstances and conditions, and seem to care even less for its particular problems. And yet, in proportion to the capital outlaid upon it, it is one of the most profitable of all our chemical industries, coal-tar colours not excepted.

Fuel economy, and the proper utilization of coal, whether in connection with manufacturing operations or domestic heating, will become one of the most important national questions during the trying years that will follow hard upon this war, because of all directions in which national economy can be most healthfully and advantageously exercised, this is perhaps the most obvious and prolific. For it is tolerably certain that, with an efficient and systematic public supervision of fuel consumptions, we ought to be able, even with existing appliances, to save many millions of pounds of our annual coal bill, and with improved appliances still more millions—a saving which would in the long run redeem a considerable amount of the war loan which has been much more easily raised than it will be repaid.

Now, I fear that not only are chemists for the most part lamentably ignorant of the nature of coal, and of modern fuel technology, but they have been for many years past so indifferent about such questions that they have been content to leave them almost entirely to engineers who, as a body, are notoriously deficient in chemical sense and experience. The engineer has indeed not usurped the place of the chemist, but has had to do his best to fill the position long since abdicated by the chemist.

This, indeed, seems strange when we remember that the foundations of Modern Chemistry were deeply laid by investigators who were, above all things, "fire-worshippers." But, judging from most chemical text-books, nearly all that the modern student of chemistry is taught in our academies about combustion was known to Lavoisier; and I question whether in the majority of our University laboratories any investigations on coal or combustion is ever undertaken. And yet the subject is full of most fascinating and fundamental theoretical problems—for the most part unsolved; and the nation consumes every week as much coal as could be exchanged for the whole quantity of aniline dyes used by its textile industries in a year.

Moreover, such advances as have been made during recent years, and they are by no means inconsiderable, have nearly all been in the direction of the wider applications of gaseous fuels. Yet in how many of our University laboratories is even gas analysis taught, or how many of our Schools of Chemistry provide systematic courses in the chemistry and manipulation of gases, without which no professional training of industrial chemists, however much "research work" it may include, ought to be considered satisfactory? It is my opinion that this important branch of our chemical craft and science has not, for many years past, been accorded its proper place and share of attention in the ordinary curriculum of the majority of our academic institutions.

Of the 189 million tons of coal consumed in the United Kingdom in the year 1913, about 40 million tons, or (say) approximately one-fifth of the whole, were carbonized either in gas-works, primarily for the manufacture of town's gas, or in coke-ovens for the manufacture of metallurgical coke—in practically equal proportions. Two-thirds of the latter was carbonized in bye-product recovery plants; the remainder in the old wasteful beehive ovens. So that, roughly speaking, we have—

Total Coal Carbonized = 40 Million Tons.

In Gas-Works.	In Bye-Product Coke-Ovens.	In Beehive Coke-Ovens.
20 ..	13·5 ..	6·5

At present there are 8297 bye-product coke-ovens built in this country, of which 6678 are fitted with benzol recovery arrangements, capable of producing something like 10 million tons of coke per annum.

The yields of the various bye-products obtainable on such coke-oven installations naturally vary with the locality and character of the coal seam; but they probably average somewhat as follows—expressed as percentages on dry coal carbonized:

District.	Ammonium Sulphate.	Tar.	Benzol and Toluol as Finished Products.
Durham	0·9 to 1·45	2·5 to 4·5	0·6 to 1·0
Yorkshire	1·3 to 1·5	3·5 to 5·0	0·9 to 1·1
Derbyshire	1·3 to 1·6	3·5 to 5·0	0·9 to 1·1
Scotland	1·4 to 1·6	3·5 to 5·0	0·9 to 1·1
South Wales . . .	0·9 to 1·1	2·0 to 3·5	0·6 to 0·75

Or, to put the matter a little differently, each ton of dry coal carbonized yields from 20 to 35 lbs. of ammonium sulphate, from 56 to 112 lbs. of tar, and from 2 to 3½ gallons of crude benzol, &c.—according to the locality. About 65 to 70 per cent. of the crude benzol is obtained as finished products—benzene, toluene, solvent and heavy naphthas.

How rapid has been the development of the bye-product coking industry in this country during recent years may be judged from the following official returns of the quantities of ammonium sulphate annually made by such plants, as compared with the corresponding quantities produced in gas-works.

Tons o Ammonium Sulphate Produced in

Year.	Bye-Product Coke-Oven Plants.	Gas-Works.
1903	17,435 ..	149,489
1908	64,227 ..	165,218
1913	133,816 ..	182,180

In the natural course of events, the final disappearance of the wasteful beehive coking-oven from this country is now only a matter of a few years; but I venture to suggest that public interest would justify the Government fixing, by law, a reasonable time-limit beyond which no beehive coke-oven would be allowed to remain in operation, except by express sanction of the State, and then only on special circumstances being proved.

There is also much need of a better and more systematic chemical control, in the public interest, of bye-product coking plants. At present, in far too many cases, the chemists employed in coke-oven laboratories are men who have practically no chemical training other than that obtained in evening classes. And, with

few exceptions, the chemist, however competent he may be, is entirely subordinated to the directing engineer, and regarded as a mere routine analyst. I can say, from personal knowledge, that plants which are managed and controlled by experienced chemists of broad training, combined with force of character, yield much better results than those which are controlled by men without such qualifications.

And even in this crisis when so much depends on plants working not only at their maximum output capacities but also, chemically speaking, under conditions calculated to ensure the highest yields of benzol and toluol—with a proper selection of coal, I doubt whether the measures which have been taken to advise and supervise the coke-oven industry are really adequate from the point of view of chemical control. I do know, for instance, that the experience and resources of the majority of our University Departments of Applied Chemistry which specialize on Fuel Technology and cognate matters have not been as fully utilized as they might have been in this connection. I cannot for one moment imagine a similar state of things being permitted in Germany, where we may be sure that nothing is being left undone in the way of fully utilizing all the available expert chemical and engineering knowledge which can be brought to bear on this important aspect of war munitions; and I venture to say that, whatever may be the case in this country, in Germany at least the staff and resources of no publicly maintained Department of Fuel Technology will not be fully employed on war problems.

The coal-gas industry, which deals with some 20 million tons of coal per annum, has, especially within recent years, shown a growing appreciation of the aid of chemical science, in regard not only to the actual manufacture but also to the domestic and industrial uses of coal gas. The endowment by the industry, in 1910, of a Special Chair at the Leeds University, in memory of the late Sir George Livesey (of which I had the honour and pleasure of being the first occupant) was a sure sign of the faith of its leaders in the value of scientific research into its special problems; and, from personal knowledge and intercourse with gas engineers, I can assure my chemical colleagues that any serious interest taken by scientific chemists in these problems, or in training men to tackle them, will be welcomed by the industry, no matter from what quarter such help or interest may come. For although the carbonization of coal in gas-works is efficiently carried out, no one in the industry supposes that finality has been reached, or that existing methods and conditions cannot be improved under better chemical control.

And, moreover, the gas industry has just recently given a striking example of the public benefit which may accrue from the whole-hearted co-operation of the chemist and engineer in the new nickel-catalytic process for the removal of carbon bisulphide from coal gas, which has been worked out, and brought to a successful issue, by the combined skill and efforts of Mr. Charles Carpenter, D.Sc., Mr. W. Doig Gibb, and Mr. E. V. Evans, of the South Metropolitan Gas Company. They have shown that the sulphur content (as CS_2) of London coal gas can be reduced on a large scale, in regular day to day working, from nearly 40 to about 8 grains per 100 cubic feet, without in any way deteriorating the quality of the gas, at a cost (including interest and depreciation) of 0·299d. per 1000 cubic feet. Such a striking success was, as Mr. Carpenter acknowledges, only achieved "because of the unrestricted and unreserved collaboration of the chemist and the engineer." Incidently the gas industry is to be congratulated on this tacit abandonment of the old contention that coal gas was either none the worse for the presence in it of a certain amount of sulphur compound or (alternatively), if worse, that a minute amount of sulphur dioxide in the atmosphere of a living room is so rapidly absorbed by the ceiling that its harmful effects are nullified.

As the outcome largely of the work of the Joint Committee appointed in 1907 by the Institution of Gas Engineers and the University of Leeds (of which I was a member) to investigate gas-fire problems, the manufacturers of these appliances have paid much more attention than formerly to the scientific aspects of construction, so far as to ensure the best combination of radiant and ventilating effects; and nearly all the larger firms have now their scientific staffs busily employed in making further advances. Prominent among the pioneers in scientific gas-fire construction has been Mr. H. James Yates, who will to-morrow enlighten you as to some of the most recent improvements. I can, however, from personal knowledge, testify to the enterprise shown by most of the leading manufacturers, and that their combined efforts have resulted in a very efficient and perfectly hygienic domestic gas-fire. A Committee appointed by the Institution of Gas Engineers, upon which scientific men are largely represented, is now considering the adoption of a standard method of testing the radiant efficiencies of gas-fires. Thus no one can say that the gas industry is not making every effort to put its affairs upon a thoroughly scientific basis.

Passing on to the metallurgical and allied industries (who, of course, are large consumers of fuel), there is much here to be done in improving the construction and operation of furnaces in order to check the waste of fuel. But of these details there is no time to treat; and one instance of the possibilities of very large economies as the result of scientific control must suffice.

It is perhaps common knowledge that the most economical arrangement of plant for the manufacture of iron and steel is one in which bye-product coke-ovens, blast-furnaces, steel furnaces, and rolling mills are brought together on one site and under one organizing direction; so that the surplus gases from the coke-ovens and blast-furnaces may be utilized to the fullest extent. My relative, Mr. T. C. Hutchinson, of the Skinningrove Iron Company, who has devoted many years of anxious thought and practical study to this important problem, ventured some few years ago to predict that—with the most approved type and arrangement of plant, working under strict scientific control by competent chemists—it would soon be possible to make finished steel rails or girders from Cleveland ironstone with no further consumption of coal than is charged into the bye-product coke-ovens for the production of the coke required for the blast-furnace; and all subsequent experience at Skinningrove has fully demonstrated that his prophecy can be fulfilled in everyday practice. Of course, it means a constant watchful control by a well-paid and competent scientific staff under efficient leadership; and in Mr. E. Bury—an old Owen College student, trained in an atmosphere of "gas and combustion"—we have found the very man for the work.

It is perhaps unnecessary, even had time permitted, for me to multiply instances of possible economies in other important directions—such, for instance, as power production and the heating of domestic apartments. There is probably no direction in which equally good results would not accrue with proper scientific application and control as those already cited as having been reached in the direction of carbonization, or in the iron and steel industry. To-morrow we are to discuss the important subject of smoke prevention, in which many Manchester public men are showing an active interest; so that there will be some further opportunity of referring to the matter.

But may I, in conclusion, appeal in all seriousness to chemists and scientific men generally to take up this important matter effectively as a public duty at this crisis in the country's affairs. I would suggest that the Government be memorialized with a view to the establishment of a central organization for the supervision of fuel consumption and the utilization of coal somewhat on the lines of the existing alkali works inspection, which has been so beneficial to chemical industry. And in connection with such an organization there might be undertaken a much-needed systematic chemical survey of British coalfields, as well as experimental trial of new inventions for fuel economies. There would certainly be no lack of important work for such a properly-organized department of the State; and there can be no doubt at all that the results of its activities would be not only a very large direct saving in our colossal annual coal bill, but also a purer atmosphere and healthier conditions generally in all our large industrial areas.

Gas-Flame as a Metal Colouring Medium.

According to "Metal Industry" [quoted by the "Ironmonger"], what is known as the French grey or smoke finish on aluminium is produced by the aid of gas-flame. The method is to lacquer the articles with a gum lacquer or a lacquer that contains a fair percentage of gum, so that under the influence of reheating the lacquer becomes resilient. After the lacquer is applied and becomes cool, the articles are handled with suitable frames made from iron wire, used from the inside when possible—a plan which obviates the risk of finger-marks caused by the softening of the lacquer. A permanent gas-flame should then be arranged, with a protection from draughts by a glass or wooden frame extending on each side and at the rear of the flame. The flame should not be too strong; the idea being to produce a flame that will yield as much smoke as possible. The lacquered articles are manipulated over the flame in such a way that anything from a mere shading to an intense black colour is produced at the discretion of the operator. After the smoke-black result is obtained the articles are allowed to cool, and should then be wiped with boiled linseed oil or immersed in a warm bath of the oil. This gives a lustre to the smoke-black impregnated in the lacquer without affecting or reducing it.

The Last of Fishtail Burners in Berlin.—Last week's "Ironmonger, in a page of "German News," states that the Berlin Municipal Gas-Works and the English Gas Company of the same city [the Imperial Continental Gas Association] announce that from the middle of September the constitution of the coal-gas supplied will be so altered that it will be impossible to use fishtail burners. As there are still a number of such burners in use in some of the poorer quarters, house-owners are warned to replace them in time with incandescent mantles.

Safety of Gas Lighting.—The "American Gaslight Journal" for Aug. 23, wrote: The comparatively safety of gas is well illustrated by figures taken from the report of the Fire Insurance Commission of Texas, dated April 19 last, covering particulars of 49,000 fires occurring in the State since Dec. 10, 1910, as reported to the State Fire Marshal. The statistics show with marked effect, the reliabilty of gas in the household, as contrasted with other sources of light and fuel. The number of fires reported Dec. 19, 1910, to April 19, 1915: Traceable to gas, 908; to electric current, 2447; to gasolene and kerosene, 2492. The number of fires caused by coal and wood stoves were: From stoves, 2749; from flues, 3996; from ashes, 940. Coal and wood stoves, with their attendent flues and resulting ashes, have been responsible in about four-and-a-half years for 7685 fires, or eight-and-a-half times as many fires as were chargeable to gas in the same period.

DISCUSSIONS AT THE NORTH BRITISH ASSOCIATION MEETING.

In last Tuesday's "JOURNAL" there were published the four papers read at the recent annual meeting in Edinburgh of the North British Association of Gas Managers, together with the discussions on two of them. The shortness of the time at disposal before going to press compelled the holding over of the reports of the remaining two discussions; and these are given to-day. They are on the paper by Mr. R. W. Cowie, of Dalkeith, entitled the "Training and Education of Gas-Fitters," and that by Mr. William Gordon, of Edinburgh, on "Gas Measurement: Past, Present, and Future."

GAS MEASUREMENT: PAST, PRESENT, AND FUTURE.

[See *ante*, p. 515.]

The PRESIDENT (Mr. J. B. Scott, of Cowdenbeath), in opening the discussion, said he felt this was a paper which it would be profitable to them to read many times over. It was interesting to learn that, in the early days of gas making, men were anxiously trying to discover some fair and equitable method of measuring gas. It was all the more creditable to the pioneers in this direction to find that, in certain appliances, few alterations of a material character had been made down to the present day. The correct measurement of gas was undoubtedly a subject of considerable importance to them all; and he believed when Mr. Gordon's paper was published, it would stimulate and encourage a belief among the consumers that, after all, their interests were being pretty well looked after. They would be encouraged to realize that in these times they were buying their gas fairly, and that the instrument which registered the consumption was, to all intents and purposes, as perfect as human skill and ingenuity could render it. In the course of his paper, Mr. Gordon made an interesting comment to the effect that gas was the only illuminant supplied to consumers through instruments which were officially tested for accuracy under conditions as prescribed by Act of Parliament, and that so much as this could not be said for the rival illuminant. The day, however, might come when those identified with the rival movement would find a meter that would prove to be equally as accurate as the gas-meter; and after all he did not think that this would really be a bad thing for the gas industry. In his opinion, if the majority of people had to pay for all the electricity they actually used, their accounts would be very much higher than they were now. Personally, he knew some instances where the consumers could use a certain amount of current, and yet the meter never turned a wheel in registering it. It was only when the consumption reached a particular standard that the meter began to register at all. He did not think they could say that of the gas-meter.

Mr. ALEX. WILSON (Glasgow) said the paper furnished an interesting historical record of what had taken place in connection with gas measurement, and it testified to the standard of accuracy to which the meter had been brought by manufacturers. It was wonderful to note the results disclosed in one of the tables accompanying the paper—namely, that, although the pressure varied from 0·5 inch to 4 inches, the result all over was the same. There was something about this that he did not quite like; it was, he thought, just too strikingly accurate. When the pressure was increased to such an extent as 4 inches, there ought surely to be a variation in the result. The figures which were given should certainly ease the public mind. When disputes arose as to the accuracy of meter-reading, it would be well worth while to have a copy of Mr. Gordon's paper handy, because it seemed to him (Mr. Wilson) that a definite pronouncement on the subject from an authority like Mr. Gordon ought to carry some weight.

Mr. S. B. LANGLANDS (Glasgow) said that, as official meter-tester in the City of Glasgow, he felt it would be wrong on his part not to rise and thank Mr. Gordon for the clever paper he had given to the Association. It was a paper in which there was a grain of humour as well as an accurate and careful review of all that had transpired since the early days of gas recording. The Sale of Gas Act was one of those almost perfect Acts of Parliament framed as it was, first, in 1859 and very slightly altered in 1860 and 1864. To-day the only divergence from the original condition of working was that the test was to be carried out at 0·5 cubic foot when the normal conditions of working were 3 inches pressure. If they turned to the text of the paper it would be seen that in a series of tests where the pressure ranged from 0·5 inch to 4 inches there was actually no variation in the result recorded by the meter. For his own part, he (the speaker) would prefer to see the Act more in conformity with present conditions of working. He did not know that he would go the length of changing the ½ inch pressure test, but thought there should be a second test at normal pressure, which would be a satisfactory verification of the first test. Proceeding, he (Mr. Langlands) said that he had been particularly interested in Mr. Gordon's remarks about a high-pressure meter test. Just now there was no high pressure meter on the market which could be called a meter, in the sense that a meter of the lower-pressure type was a meter. It was true there were many appliances on the market which went by the name of high-pressure meters; but he doubted if there could be the same accuracy. Indeed, he made bold to say that there was not. There was plenty of room for the inventive genius of gas engineers to bring a perfect instrument on to the market. The author, it would be noticed, put forward a plea for the standardizing of high-pressure meters, and he quite agreed with his observations in this connection, though he would rather prefer that the meter should meet the variations of pressure than that the pressure should be kept equal throughout. Personally, he might explain that he was going forward this year to obtain the power that the London County Council secured for testing high-pressure meters; and he was doing so in the hope that a perfect system of measurement would be evolved. By-and-bye he hoped that Mr. Gordon would see his way to complete his history of the whole question from the early days down to the present time. If the author did this in the same lucid and informative way as he had prepared the present paper, they would then have a record of very great value indeed.

Mr. ALEX. YUILL (Dundee) said he, like Mr. Wilson, felt that the paper was most instructive. In a sense it was partly historical and partly descriptive of the work in which the author was engaged. While the figures that were referred to by the last speaker were rather surprising, still the results were nothing more than they might expect from a meter manufactured by a firm on whom they could place entire dependence. There was one point he must mention, which was that the continued registration at 1·01 per cent. for pressures varying from 0·5 inch to 4 inches was not quite what he would have expected. At the same time he was quite willing to take the figures as Mr. Gordon had given them. There was one other point on which the author might give them further information. He (Mr. Yuill) presumed the 4-inch pressure was the pressure at the inlet of the meter; and if they maintained a pressure of 4 inches to the outlet of the meter, they were measuring a cubic foot. A cubic foot of a gas, even supposing it differed in specific gravity, was still a cubic foot of the gas being dealt with. The point he would like to know was this, What was the pressure at the point of ignition? If the pressure at the point of ignition was 4 inches, then this bore out the accuracy of the meter. Dealing with the other table in the paper, where there was recorded the consumption per hour at varying pressures, another very interesting question arose. Hitherto they had been under the impression that, if they doubled the pressure, they would increase the volume by 50 per cent. He found from the table, however, that by increasing the pressure from 0·5 inch to 1 inch, the consumption per hour increased from 30 per cent. to 43 per cent.; while an increase of pressure from 2·5 inches to 3 inches showed merely an advance of under 10 per cent. in the consumption per hour. In his paper the author had made reference to uniform pressure and the standardizing of high-pressure meters. It seemed to him (Mr. Yuill) that it was essential for them as gas engineers ever to keep before them the necessity of giving what was termed a "uniform pressure" to the consumers at all times. This could only be done by having an unusual pressure in the mains, and so be in a position to supply it to the consumers when and if required. They would need to have the pressure governed at the consumers' meters so as to give the uniform pressure at the point of ignition.

Mr. WILLIAM WILSON (Falkirk) remarked that the paper had fallen like a meteor among them, because of late they had heard so much of vertical retorts *versus* horizontal retorts that it was quite refreshing to get back again to the Sale of Gas Act. Like Mr. Yuill, he had been struck with some of the figures in the paper; and his colleague from Dundee had forestalled him with the very question he had intended to ask. He really, however, did not think Mr. Gordon had gone far enough with his first table, because the consistency and accuracy there depicted were always what he (Mr. Wilson) imagined would take place on a restricted output. If Mr. Gordon would tell them whether a cubic foot of gas at 4 inches pressure (passed out of one holder into another) would occupy at the end 1 cubic foot, that would set their minds at rest as to the actual accuracy of their meters at varying pressures. The second set of figures was, he thought, really more astonishing than the first; but he could not challenge them because he believed they were, in all probability, most accurate. It was surprising to notice that the meter registered exactly the same result above the first ½ inch of pressure—between 1 inch and 3 inches—notwithstanding the enormously increased volume of gas which was being passed. Mr. Yuill was quite correct, in a sense, in saying that, when the pressure was doubled, the volume was increased by one-half; but he (Mr. Wilson) thought there was another factor to be taken into consideration here. This was the friction of the meter, and the rapidity of the movement connected with it. There was bound to be, as a result, a more retarding effect. He was very glad indeed that Mr. Gordon had refreshed their memories on the point that electrical meters were not perfect. It was a point which he (the speaker) raised with considerable effect in his own town when they were booming high-pressure gas against electric lighting. His Town Council decided

that they would test the two illuminants for themselves; and he (Mr. Wilson) explained to them that he was quite prepared to carry out the test in opposition to the Electricity Department if the Town Council undertook to see fair play. He asked that the Town Council should insist on the Electricity Department putting in electric meters which had been duly sealed and attested by the Board of Trade. It was unnecessary for him to add that the Electricity Department could not produce the meter.

Mr. SAMUEL MILNE (Aberdeen) said it was some years now since he was associated with the testing of gas-meters; but he could recall that there were at the time certain fixed notions in his mind. One of these notions was that, if they overdrove the meter, there was a tendency for it to go slow; while if it was underdriven there was an aptness on its part to go fast. He was agreeably surprised to notice one of the tables given by Mr. Gordon, and had also observed some later remark—viz., "The volume of gas varies very considerably under compression," &c. It had been a most interesting experience indeed to have had this historical review of gas-meters and gas measurement; and it would appear as if they had reached perfection even as far back as 1859, when the Sale of Gas Act was passed. It had often appeared to him that the provisions of the Sale of Gas Act were not quite satisfactory on one notable point. Why, for example, should they be called upon to test at ½-inch pressure, and restrict the amount of gas passing through the meter when, as someone had remarked in the course of the discussion, the normal pressure was something approaching 3 inches? If it was a five-light gas-meter they did not know whether it would be required to deal with 30 or 60 cubic feet of gas per hour. In one of the tables in the paper it would be seen that, at 3 inches pressure, there was a consumption per hour of 75 cubic feet, and 30 cubic feet at a pressure of 0·5 inch. He was not aware there was such an extraordinary range in the delivering capacity of a five-light dry gas-meter; and he was wondering if there was anything special about the meter which had been so tested by Mr. Gordon. He (Mr. Milne) was hopeful that they might have had from Mr. Gordon some of his experiences in the testing of old meters. Personally, he knew of one meter inspector who had received a meter from an outside complainer, and on testing it he found it was wrong. Before issuing his certificate he tested it again and found it right; a subsequent test showed it to be once more wrong; and as the outcome of much testing and retesting he could not in reality say in what condition it stood. He (Mr. Milne) could not say whether or not the inspector finally condemned the meter. If the author could narrate some of his experiences in this direction, they would certainly prove most interesting.

Mr. J. W. NAPIER (Alloa) said there was no doubt suppliers of electricity were at a disadvantage, compared with gas engineers, in regard to meters. The trouble came to be in cases where a large meter was installed, and the consumer used only a single light. In such a case it was quite true that the electricity department suffered very serious loss; and it was to the advantage of the electricity departments to exercise great care in seeing that the meters fixed for consumers—more especially lighting consumers—were not too big. He had found it necessary in Alloa to change all electricity meters in the establishments of the largest lighting consumers, simply because, in almost every instance, it was found there was a loss in consumption. The lessened consumption of energy in a more efficient lamp did not prove sufficient to make the meter work and record satisfactorily. At the same time, he believed that the electricity meter, for all practical purposes, was quite a satisfactory measuring instrument; and neither the consumer nor the electricity department had much to complain of at present. He was not at all surprised at the results obtained by the author of the paper, all of which went to prove that the accuracy of the gas-meter was maintained whether the pressure was ½ inch or 4 inches. He thought it would have been of the greatest interest to the practical gas engineer to have heard from the author what degree of error entered into the meters that were passing a greater volume of gas than was stipulated for. They recognized that the two-light meter had got out of date; and this size was not sufficient when regard was paid to the number of gas-cookers and gas-fires that were to be found. On the other hand, having regard to the large capital expenditure which was involved in the purchase of meters, they naturally were somewhat reluctant to change to the larger sizes. It would be exceedingly valuable information if the author could tell them whether the range of error was considerable in the ordinary sizes of meters which were working beyond their rated capacity.

Mr. GORDON, replying to the discussion, said when writing the paper he had in view the desirability of allowing laymen or the consumers to grasp certain facts from it. He preferred that it should serve this useful purpose rather than for it to bristle with technicalities. He was glad the paper had given rise to a discussion, because after all a paper was hardly worth writing unless there was a little difference of opinion about it. Regarding the remarks made by Mr. Wilson, of Glasgow, he might say that it was the somewhat extraordinary result recorded by the meter in question that caused him to give it prominence in the paper. He might mention that the President of the Association only allowed him a mere matter of a couple of days in which to prepare the paper; and as a consequence he had to get together some old data. He came across in a letter book the figures he had given; and he thought they were well worthy of being reproduced. In the table referred to by several of the speakers, one interesting feature would be observed—that, while multiplying the pressure by four, they were doubling the consumption. This had generally been his experience in testing gas-meters. A suggestion had been made by Mr. Langlands that the indices should be stamped; but the unfortunate thing was that what would be a three-light meter with one maker would not be regarded as a three-light meter by another. It seemed to him (Mr. Gordon) that the elucidation of the whole problem was to be found in the standardization of the maximum. So far as the question put by Mr. Wilson, of Falkirk, was concerned, he would remark that it was impossible to pass the pressure from one holder to another. There must be an atmospheric pressure to enable the carrying to be done from one holder to another; and unless there was a necessary weight put on to transfer the gas from one holder to another, it would be stationary. In regard to compression, he thought that the difference between ½ inch and 4 inches was so small that it must have little effect on the volume. The difference would in all probability be most apparent when the highest pressure was reached. The London County Council, as was well known, had to some extent anticipated them all by getting powers from the Legislature to test meters under high pressure. Now that they had such permission, they would require to go ahead and devise an instrument to give effect to the powers which they possessed. Frankly, he was hopeful that, in course of time, these same powers would be made applicable throughout the whole of Great Britain. As an official under the Sale of Gas Act, he was only allowed to test in terms of the Act. It could only be as an official of the municipality he could give his experience as to old meters.

TRAINING AND EDUCATION OF GAS-FITTERS.

[See *ante*, p. 518.]

The PRESIDENT (Mr. J. B. Scott, of Cowdenbeath), in opening the discussion, remarked that there were few gas managers nowadays who had not one or two gas-fitters in their employment; and they would agree with him in saying that the chief difficulty experienced was in making a proper observation of the work done by these men. The fitters left the works with a certain amount of work to perform; yet when they entered the homes of consumers they were left, as it were, pretty much to the freedom of their own will. It was almost impossible—even in a city where there was a large staff of inspectors—to keep a careful watch over the work done by the fitters; and the difficulty was accentuated in the smaller towns, where, as a rule, the manager had generally enough to get through without chasing these fellows, to see whether or not they were making a good job. There was no doubt that the efficient education of the gas-fitter was an important solution of an interesting problem. If they were to have any ease of mind at all, and were desirous of doing their best for the consumers, they must adopt some system of educating the gas-fitter, so that he would become an individual of knowledge and sense. They wanted him to become possessed of sufficient good sense to realize that he was sent among the consumers largely on his own responsibility, and, on this account, was expected to make a thoroughly satisfactory job of everything he took in hand.

Mr. RALPH HALKETT (Glasgow) said that in large towns facilities in regard to education were open to most of the gas-fitters; and in this respect they enjoyed a considerable advantage over their colleagues in smaller towns. His feeling, however, was that the fitters did not take advantage that they ought to do, even in the larger centres, of the facilities and classes; and it was for gas engineers to impress upon them the benefits derivable from such a course of education. In the smaller towns the difficulty, he admitted, was not easy to overcome; for the simple reason that the fitters had not the same facilities in relation to classes and teachers. To his mind, however, the difficulty could be got over if there was at different centres a recognized teacher to whom all fitters within a radius of from 12 to 15 miles could go. He believed a plan on similar lines to this had been inaugurated by the Manchester District Gas Institution, and they were hoping that in the coming winter it might be attended with great success. In the course of his paper, Mr. Cowie had also dealt with the scheme set in operation by the Edinburgh and Leith Gas Commissioners for the education and training of gas-fitters. There was no doubt this was a very valuable scheme, and one from which apprentices should in the future greatly benefit. It was felt now as a real necessity that the gas-fitters of to-day should be educated in regard to the problems and difficulties which were being met with in the gas profession; and it was with this object in view that the Institution of Gas Engineers co-operated with the City and Guilds of London in arranging for examinations. The first examination, as most of them knew, took place this year; and they could say with regard to it that it had been, on the whole, very satisfactory. In the final grade he believed 48 sat; and the other figures were: Grade II., 76; and Grade III., 136. In this connection, he should like to say he did not think Scotland was as far advanced as it really ought to have been. He believed Glasgow was the only centre to put forward candidates for the examination. This was not what it should be; and he hoped means would be taken to ensure that Scotland had a few more candidates at next year's examination. He was glad to note that the Institution had rightly adopted the idea of giving certificates to those gas-fitters who were really competent men—men who did not feel disposed to sit, or were not able to take an examination, but who, from the point of view of the gas industry, were quite

capable members of the staff. The Institution had very rightly considered that such men as these might be put to a great disadvantage if they were asked to compete alongside their younger colleagues; and so, up to 1916—provided the application form was completely and satisfactorily filled up—certificates would be granted. The possessors of these certificates ought not in the future to be allowed to lie dormant. There might be a disposition among them to think, now that they were fully qualified, they could drop their attendance at the classes; but care should be taken to guard against this. To overcome the difficulty, he would suggest that periodical lectures should be given to the men in the various departments, with the view of brushing them up a little, and not permitting them to forget what they had learned. He should like now to refer to one sentence in Mr. Cowie's paper which required a personal explanation—viz., "As Mr. Halkett pointed out in his report on the examination in Glasgow, this inability to express themselves in words was one of the weakest points." Speaking of the examination in general, he (Mr. Halkett) might say he was not aware who the individual candidates were when marking the papers.

Mr. DAVID VASS (Perth) said the war had upset all their calculations considerably; and any attempt to organize classes in certain districts had failed on this account. He thought, however, this was a question which ought to be kept very prominently before them, so that in the future they would have classes, not only in Glasgow, but also in Edinburgh, Dundee, Aberdeen, and many of the other large centres. It would be recalled that, in his (Mr. Vass's) Presidential Address last year, he dealt a little with the apprenticeship question; and he was still disposed to think a solution of the difficulty would be found in a scheme for the training of apprentices in the large cities. In this way, qualified men would be found for the smaller towns. Prior to his appointment as gas engineer in the city of Perth, an attempt had been made to train lads; but the idea had only been developed in a haphazard way. When, however, he took over the duties in Perth, he tried to extend the knowledge of the lads by giving them a training in, and passing them through, the various branches. Up to this time, the lads were only assistants to the men. Their work embraced little more than merely carrying tools; and in no way whatever were they receiving practical insight into their business. He arranged that each apprentice was to have a spell of training in the repairing shop, so that he might learn all about the apparatus and its different parts. This was followed by a course of training in the meter-shop, when opportunities were afforded the apprentices of observing and assisting in the repair of meters. It was further arranged that some little time should be spent by the lads in the stores department; and in this way they became accustomed to the handling of material which was to go out to the different jobs. In Perth, they had experienced one difficulty. It was a bit of a stumbling-block, because it had emanated from the tradesmen who were plumbers. The latter objected that the training the apprentices were receiving did not fit them to become either plumbers or gas-fitters, and that, in point of fact, they would be little more than half plumbers and half gas-fitters. Of course, he (Mr. Vass) did not wish to have the apprentices trained altogether as plumbers; but his desire was to have them made thoroughly competent as gas-fitters who possessed sound practical knowledge of gas appliances. One difficulty which they experienced, further, was that the lads could not join the Plumbers' Association; while there was no gas-fitters' union in Perth; and, of course, it could not be claimed that the apprentices were tinsmiths. This was the attitude the trades union had adopted; but it seemed to him they must look to the gas-fitting apprentices themselves to get over the difficulty, and have gas-fitting recognized as a separate and distinct trade. There was quite sufficient scope in the gas profession for the training of men to have a special knowledge of gas appliances, independent of the plumbing or tinsmith trades. Unquestionably, this was one of the points they would have to stand up and fight for—namely, to have gas-fitting recognized as a trade by itself. The paper Mr. Cowie had read teemed with most interesting suggestions; and he had the feeling that it would prove useful and helpful. At first, he had experienced some difficulty in getting the men to subscribe for a weekly copy of "Gas: Light, Distribution, Maintenance;" but this had now been overcome. Apprentices were given copies of the paper free of cost, with a view to keeping them in touch with their work. He was hopeful that, when the apprentices returned from the war, they would continue their studies and training with the same enthsiasm as in the old days.

Mr. ALEXANDER MASTERTON (Edinburgh) observed that Mr. Cowie had given a lucid outline of the scheme for training gas-fitters which was being carried out in Edinburgh. He might add that the scheme had proved to be quite an effective one; and up to the outbreak of the war they were getting around them a good set of tradesmen, who were taking an intelligent interest in their work, and doing all they could to make themselves efficient gas-fitters. Then, again, the Gas Commissioners, in order to further encourage the apprentices, guaranteed at the beginning of each session the refunding of fees; and at the close of the course only those lads who had not behaved, or who had failed to reach a sufficiently high standard of merit, did not receive their class fees. After serving their apprenticeship, the lads were put into the meter-reading department. In this way they came in close contact and actual touch with the consumers; and being conversant with the practical side of the business, they were able to discuss intelligently with the consumers propositions for the expansion of the gas supply. Further, these men could be sent out to investigate complaints; and they were quite capable of preparing a practical report on what was required. With regard to the Institution's scheme for the certification and registration of gas-fitters, the one aim of the Institution was that those men who, through no fault of their own, had got beyond the age when they could reasonably be expected to study and prepare for examinations, should not be debarred from the advantages of certification and registration. This to his mind was quite a reasonable claim on behalf of a body of men who were intelligent, trustworthy, and capable workmen. Though this examination scheme threw a considerable onus and responsibility upon gas engineers, he personally thought no one would grudge that, if it was going to be for the benefit of the industry. No doubt it was difficult to forecast how the scheme would develop, or what the results would be; but, at any rate, it was worthy of their whole-hearted support, and they should do what they could to give it a fair trial.

Mr. C. P. MYERS (Troon) said the author was to be congratulated on bringing under their notice a subject well worthy of attention. The consideration which the scheme had received in the course of the discussion had so far been from the standpoint of the larger towns of Scotland; but in anything he had to say, he would approach the subject rather from the view-point of the villages and smaller towns throughout the country. At more than one meeting of the North British Association, he had felt somewhat depressed that the trend of the discussions had been to bring forward points for the consideration of gas engineers in Perth, Dundee, Aberdeen, Glasgow, and Edinburgh. It seemed to be forgotten that much of the gas manufactured in the country was made outside these royal burghs and populous areas. It appeared to him that, however true to the situation the scheme outlined by Mr. Cowie might be, however well it might fit in with the needs of the places he had already named, Mr. Masterton had let out the real secret. That gentleman had clearly indicated in the course of his speech that it was chiefly for the supply of meter inspectors that this scheme had been launched. Consequently, he (Mr. Myers) did not think the method which had been outlined would at all suit the smaller towns. In his county—Ayrshire—probably the largest employers of gas-fitters and plumbers were the Glasgow and South-Western Railway Company and Nobel's Explosives Company, at Ardeer. The experience of both these large corporations had gone to show that they could get the best men from the small workshops of private traders. The proposed new departure which had been outlined for them was quite in the line of modern teaching—the elimination of the private trader. It aimed at getting the work done by the corporation direct; but, to his way of thinking, it was in the interests only of the gas appliance makers and the metal merchants. The lads who were trained under the conditions sketched out would not work so economically as they would do for the small private trader on contract jobs. Lads who were brought up under a private trader were taught the principles of economy—the all-important question of economizing material and labour. He took it that in working for corporations the old phrase would still prevail: "It is a good strong concern, and there is no need to economize." It was all very well to specialize; but their business he thought hardly offered sufficient scope for the training of young men. The mere laying of a service-pipe and the connecting-up of a meter constituted altogether too-limited a scope for training young men. Specializing was all very good for those who were old and bald-headed; but they would really require to offer something more to young men in the way of training than merely the work of laying service-pipes and fixing meters. He was one of those who still thought that they should endeavour to encourage private traders to train young men.

Mr. GEORGE BRUCE (Tayport) said he was distinctly of the opinion that, if gas-fitters were a little better paid, it would go a long way towards a more easy solution of the gas-fitting problem. Personally, he deplored the tendency which prevailed, especially in the larger gas-works of the country, to employ cheap men. There was no question that many gas managers considered it an advantage to engage someone who had been trained as a plumber with a private individual. In adopting this course, they had the feeling that they were securing a better type of workman. To his mind, it would be an infinitely better arrangement if the large gas companies and corporations would get lads from private individuals—journeymen whose period of apprenticeship was over—and then train them for the class of work required in the gas industry. Young men who were taken on in this manner were more eager to push their way in the world, and more desirous of getting to the goal which they wished to reach. If the gas companies could only be prevailed upon to pay the standard rate of wages to their gas-fitters, they would assuredly discover a superior class of workmen. As things now were—due largely to the small wages paid—they got a poorer type of tradesman. Frankly, he had been astonished to find that some gas companies and managers expected to secure a qualified gas engineer and fitter for something like 25s. a week. The managers themselves ought to see to it that the fitters received the standard rate of wages; and if this were done, they would speedily find men capable of fixing a gas-fire, installing a geyser, and doing many other jobs. He had considerable sympathy with Mr. Cowie's claims for the more efficient training of gas-fitters; and he thought gas companies and corporations ought to see that this class of workman secured better treatment as a rule.

Mr. F. W. GOODENOUGH (London), who was invited to join in the discussion by the President, said he had no qualification

which justified him in taking part in the debate, since he was neither the manager of a large nor a small gas-works in Scotland. Perhaps, however, some excuse for the invitation which had been extended to him might be found in his connection with the Metropolitan gas industry. He was very glad to have an opportunity of associating himself with the complimentary references which had been made to Mr. Cowie's paper. As they were probably aware, this was a subject in which he was very much interested, although he did not think that he had anything particularly new or striking to say in regard to it on the present occasion. The author had ventured the observation that possibly some would think too much attention was being paid to gas-fitters. So far as he was concerned, he did not think it was possible to devote too much attention to the training and education of these fitters. During the last century, those associated with the gas industry had exercised themselves in the protection and perfection of machinery and the article produced by the machinery. What they had to do now was to correspondingly perfect and protect those who had the handling of the machinery, and who also took a leading part in the public service which the gas industry rendered. If the business of gas inspection was considered to end at the meter, then this subject would have little value for them; but, in view of the fact that their business did not finish until the consumer was satisfied, and until they had induced the consumer to use as much gas as he possibly could do, the question of the training of the men to whom was assigned the duty of fixing and maintaining the apparatus became one of prime importance. Mr. Myers had put forward a strong plea for the private trader, and had contended that apprentices brought up under a private trader learned more about the principles of economy than they did in the large company or corporation gas-works. It was just because the private trader practised so much economy, both in material and labour, in fixing-up an installation in which he had no further interest after he had been paid for it, that he (Mr. Goodenough) strongly advocated that much of this work should be done by the gas undertaking, and done in such a way as to make it a source of everlasting satisfaction to the consumer. He was fully in agreement with Mr. Cowie in the remark he had made in the paper, that gas-fitting embraced such a wide field of work and science that it could well stand alone as a distinct trade. Indeed, he sincerely hoped this would be the trend of development in the near future. They wanted to train men who could not only run a service-pipe and connect a meter, but who could fix a gas-fire so as to give satisfaction, instal a good water-heater, and fix-up a furnace for any reasonable purpose in such a way as to do credit to the gas industry. Once these appliances had been installed, then the satisfactory supervision and maintenance of them followed as a matter of course. Altogether, he was firmly of opinion that the gas-fitting trade offered to an intelligent young man plenty of scope for the exercise of his brains and mechanical ingenuity. He hoped that the presentation of this interesting paper would carry further forward the good work that was already on hand.

Mr. R. W. Cowie, in reply, said he was gratified at the discussion which his paper had evoked. After all, it seemed to him better that a manager from one of the comparatively small towns should introduce a subject of this kind occasionally, because it helped to get the views of other managers who were in charge of similar works. He was specially indebted to Mr. Halkett for the observations he had made; and he quite agreed with him that possibly much good could be done by the appointment of a travelling teacher. He did not think manufacturers' representatives, if they desired to give demonstrations, should confine them solely to the large centres and towns. No doubt, bigger orders were to be obtained there; but occasional visits to, and lectures in, the smaller towns would likewise prove helpful. To these demonstrations and lectures the local plumbers could also be invited. A remark was made by Mr. Halkett that Glasgow was the only centre from which candidates in Scotland went forward to the last examination. He rather thought the reason for this was to be found in the fact that the gas-fitters in Glasgow had been kept well informed of the approach of the examination. Perhaps if the fitters in the other works centres were similarly informed in the future, it might be possible to have examinations held in the other places which Mr. Myers had mentioned. He certainly agreed with Mr. Vass that there was sufficient work and variety in gas-fitting to have it distinguished as a separate trade from that of the plumbers. Indeed, in his view, no gas-fitter could be classified as being thoroughly competent until he was able to fit up a complete hot-water service in any house or building. Frankly, he did not see why this work should be regarded as the special preserve of the plumbers. Their own gas-fitter at Dalkeith served his apprenticeship with a practical plumber; and when he came to them he was quite astonished that he had so much to learn in the way of connecting-up gas-heating apparatus. He much appreciated the remarks made by Mr. Goodenough, and hoped that the movement which had been inaugurated by the Institution would result in an earnest effort on the part of gas-fitters to increase their knowledge during the coming winter. He quite admitted that the results in work of this kind could not be seen immediately; and it would probably be a year or two yet ere they realized the full effect of the effort which had been put forth on behalf of the fitters. In districts and communities where the gas companies and corporations supplied all sorts and varieties of apparatus, it was only reasonable to expect that the fitters would thoroughly understand the appliances.

MR. YATES ON GAS HEATING AND SMOKE PREVENTION.

In the course of the debate on "Smoke Prevention," at last week's meeting of the British Association at Manchester [*ante*, p. 571], Mr. H. James Yates, of Birmingham, made some extended remarks on the subject which justify reproduction apart from our general report of the proceedings.

Mr. Yates said that, in considering the question of air pollution and smoke prevention, two main elements are generally recognized—viz., smoke from domestic fires, and also smoke and deleterious gases from industrial establishments. As regards smoke emanation from both of these sources, he said he was a whole-hearted advocate of the view that it is to the use of gas in place of solid fuel that we must look for the solution of the smoke problem.

Referring to the industrial aspect of the question, he said his own association with the replacement of many solid-fuel furnaces by gas-fired furnaces had led him to the conviction that—apart altogether from the invaluable service of these latter in connection with the present enormous output of munitions—not the least among their practical advantages was the part they are destined to play as a factor in the reduction of smoke emanation in great manufacturing establishments, and correspondingly reducing the great waste of valuable bye-products which such smoke emanation involves. He did not, however, propose to deal in detail with this aspect of air-pollution and its cure, nor did he delay to inquire whether industrial or domestic smoke emanation was responsible for the greater harm. It was his present purpose to deal more particularly with the domestic aspect of the subject; and he hoped to convince people that the prospect of a solution of the problem of domestic smoke emanation being arrived at through the medium of gas had now, by practical means with which he should acquaint them, been brought well within measurable distance.

The visible pollution of the air by smoke from domestic fires, such as one sees in the haze overhanging even a small village on a calm day, was due, like the invisible pollution that accompanied it, to the burning of coal in its crude state in open firegrates. All visible pollution, and practically all invisible pollution, arising from coal consumption, can be avoided, and all the valuable bye-products utilized, by using purified coal gas in place of the ordinary methods of burning coal.

There was, he said, no domestic operation involving the use of heat that could not be performed as well with coal gas as, and indeed better than, with coal; and if the cost of the actual fuel should be slightly more for coal gas than for coal, this was more than offset by the labour saved in many directions, and by the fact that the use of gas introduced that easy control of the heating medium which permits of perfect economy, whereas in the nature of things the combustion of coal was not subject to any such degree of control.

This had for years been widely recognized as regards the use of gas for kitchen purposes. Already the gas-cooking stove had done much to reduce coal smoke emanation from this source along with an increasing use of domestic gas-heated hot-water supply. But there was only one kitchen chimney in a house, whereas there were a number of coal grates; and the gas-fire, if it was to supersede these coal grates, and so abolish their smoke emanation, had to be so perfected as to be a substitute of more than equal adequacy; for the average man will not be persuaded to do anything towards the purifying of the air, unless he can have means offered him which save him as far as possible any inconvenience from a change of method.

Two years ago at the Birmingham meeting of the British Association, he (Mr. Yates) had been asked to contribute to the discussion on "Fuel Economy," and gave an account of the introduction of gas-fires, their continued use and development, and the objects that the introduction of chemical and physical science into the gas-stove industry had led them to aim at in the designing of such apparatus. Before describing the further important gas-fire problem since grappled with and solved—namely, that of ventilation—he desired to give a short *résumé* of the present state of development of the gas-fire.

Originally, the gas-fire was as nearly as possible an imitation of the coal-fire. It consisted of bunsen burners so arranged that their flames should play on some incombustible material, so as to bring it to a red heat or something approaching this state. It lost much heat up the chimney; and it gave very little radiant heat. The cost of the gas used was out of all proportion to the amount of heat obtained; and the fire was apt to smell, owing to the incomplete combustion of the gas. Gradually it was recognized that if gas-fires were to be made practically efficient on a commercial scale, their economic and hygienic aspects must be studied. At first, the economic aspect was almost exclusively dealt with; effort being made to extract more heat from the waste products before their escape by the chimney—the heat thus extracted being returned to the apartment as heated air. In other words, these early efforts in gas-fire economy aimed at concentrating on convected heat. There was undoubted economy effected; but it was accompanied physiologically by a bad effect. The convection currents were so hot that the percentage saturation of the air of the apartment was lowered, with the result that

moisture was abstracted from the skin and mucous membranes of the occupants, and they suffered unpleasant sensations of dryness, pricking of the skin, and so on. Further, owing to the air of the room being hotter than the walls (because of the heat being mainly transferred to the latter by the medium of the air), persons sitting near these might yet experience chilling sensations owing to the radiation from their bodies to the colder walls.

As a result of these drawbacks, gas-fire heating fell into bad repute; and the position became one only to be retrieved by most strenuous research and effort. In this fresh effort, the vital importance of the hygienic aspect was at last fully recognized. Concentration was made on radiant heat; but care was taken to avoid straining after this to an excessive extent, or in the direction of over-intensity. The bad results of high temperature convection being recognized, special convection contrivances were dropped. But the absolute necessity for retaining a certain amount of low temperature convected heat to supplement the radiant heat was not lost sight of; and express provision for this was made. Some progress was also made in improved ventilation. This represented the gas-fire position at the date of his previous contribution, already referred to.

Mr. Yates then more particularly dealt with the question of radiation and the influence on it of high and low canopies. Since that date, he had set himself the task of removing the last major objection to the gas-fire as compared with the coal-fire; and he proposed to give a brief account of the successful accomplishment of this task and of the advance effected, since all improvements tending to make the gas-fire more acceptable to the public had an important bearing on the discussion taking place.

The speaker had mentioned a short time ago the question of ventilation. In this country, people had always been accustomed to the open fire grate in their houses, and, generally speaking, depended almost entirely on the chimney for the removal of air and the ventilation of the room. This method was by no means ideal; for one thing, not infrequently the removal of air by the coal-fire *vid* the chimney had been so great that the occupants of the room had found themselves inconvenienced by the excessive draught near the floor. But as the majority of rooms in houses are ventilated by the fireplace, it is necessary, when a gas-fire is installed, that means be devised to ensure its fulfilling this function to the best advantage. This was far from being the case with gas-fire heated rooms of even a very few years ago. The fire was placed in front of the coal-grate—very often with a sheet of iron behind it, thus partly or wholly blocking-up the entrance to the chimney, except for the flue outlet of the gas-fire itself. As in many cases this outlet was of very small dimensions, the amount of air that it withdrew from the room was quite insufficient for adequate ventilation. In some gas-fires the flue vent and canopy were so designed and proportioned as to draw a large volume of air up the flue; but while in this way quite good ventilation was produced (much exceeding anything previously reached in gas-fire practice), yet even with such improved fires—free as they were from so many of the objectionable features of the old high-temperature convection gas-fires—the comfort resulting from the ample air-change effected by the coal-fire remained to seek.

Though the working of the gas-fire itself afforded entire comfort in a room, yet if it were kept going all day, it was noticeable that the atmosphere was not so pleasant as the day wore on; and in the evening, when the number of the occupants increased, and particularly if gas were used for lighting, then the stuffiness became considerable and people blamed the gas-fire. It was, indeed, the gas-fire that was to blame. It, however, had nothing to do with its own working as a fire, but was entirely due to its indirect effect on the atmosphere by blocking-up the chimney, and largely restricting the ventilation. Unless this single disadvantage under which the gas-fire still laboured, as compared with the coal-fire could be removed, the use of gas-fires, extensive though it already was, was bound to remain permanently confined to those householders who adopted it purely as a matter of labour-saving or convenience—instead of broadening, as it ought, into universal adoption—because the great body of the public would still remain more or less opposed to gas-fires on account of the stuffiness which he (Mr. Yates) had referred to, and which they would continue to associate with the gas-fire itself, although, as was explained, it was only due to this apparatus in an indirect way.

He therefore set about endeavouring to produce a fire which should give an ample and controllable ventilation of the room. This major problem was complicated by several other conditions, which, though minor in comparison, were yet of such importance that they had to be regarded as indispensable. Great practical difficulties had been experienced as regards these minor conditions—not so much in attaining them individually, as in the complicated task of reconciling them with each other in the one apparatus. By continued effort, however, the objects in view had been eventually all achieved. The fire thus produced, in addition to its embodying the various points of design and construction called for by modern practice, had the further feature (distinctive to itself) of embracing a special contrivance, simple in appearance, but for long most baffling in the course of its evolution, by which, in injector fashion, a very large amount of air was removed from the room.

Briefly described,* this contrivance provides two outlets to the chimney. The conformation of these and of the adjacent parts is so proportioned, as the result of much experimental work, that by the under outlet the entire combustion-products are carried off, while by the upper or ventilating outlet a large volume of ventilating air is removed—the volume being controllable by a ventilation regulator.

Anticipating queries that might be raised, he said he would deal first with the question of what should be considered as the degree of ventilation necessary in a living-room. It was generally accepted by the authorities that the air of the room should be changed not less than three times per hour; and to attain, and if possible exceed, this figure was the task before them. During the perfecting of this fire, many tests had, therefore, been made with a view to ensuring that its results in this regard, compared with existing gas-fires and with the coal-fire, should be such as to justify its being brought to public notice. These tests had been made in an ordinary room with a chimney 30 feet high. In a series of tests taken under identical conditions, as far as it was possible to control them, and using various makes of modern gas-fires of the same size, the following results had been arrived at:—

The new ventilating gas-fire	. .	11,800 cubic feet per hour	
Ordinary gas-fires	(*a*)	4,500	,, ,,
	(*b*)	4,850	,, ,,
	(*c*)	5,600	,, ,,
	(*d*)	5,000	,, ,,

This shows an increase to over double the air removed by the nearest ordinary gas-fire. One possible objection anticipated was the suggestion that, although the air is removed, yet it merely takes a path along the floor to the fire, and that therefore the air at the breathing level is practically stagnant. To test this point, samples of air were taken (through pipes) from points arranged along the three axes:

(*a*) At right angles to the fire, and 4 feet from the floor.
(*b*) At 6 feet from the fire, and vertical.
(*c*) Parallel to the fire, 4 feet from the floor, and 6 feet from the fire.

These axes intersected at one point.

The results of these tests proved that ventilation extended along all the axes, and at least above the breathing level, which is at a height of about 3 to 4 feet for a person sitting. Thus any possibility of merely local ventilation had been studiously avoided—the fire drawing in air from all parts of the room. He (Mr. Yates) said he had the results plotted graphically and the various sketches and diagrams, which were practically self-explanatory, showed that the ventilating gas-fire greatly exceeded the ventilating capacity of the ordinary gas-fire, and approached that of the coal-fire as closely as was necessary, or indeed desirable—having regard to the discomfort to which he had referred as sometimes experienced with coal-fires owing to their possibilities in the direction of excessive draught.

Mr. Yates closed by summing-up briefly the effect of this most recent gas-fire development in its relation to the smoke problem. Already, and apart from this development, the modern gas-fire had been taking the place of the coal-fire in many hundreds of thousands of cases. Now that it was equipped with this ventilating provision, added to the other great improvements of recent years, he regarded the gas-fire as having become more than the equal of the coal-fire in every respect; and he believed that it had now brought within the range of practical politics a vast extension of the use of gas-fires such as would amount to the practical supercession of the coal-fire throughout the country, and which, but for this ventilating provision, would have remained permanently impossible. He had already referred to the general adoption of gas cooking-stoves, and to the gradual introduction of gas-heated appliances for domestic hot-water supply. Architects had recently begun to take much interest in the progress of gas-fires, and large numbers of them were now made in the form of grates for building into fireplaces. There was thus good reason for the belief that ere long the present fashion of equipping new houses with built-in coal-grates would be gradually discontinued, and gas-grates would be built-into new houses instead.

He was far from suggesting that the gas-fires had now reached finality of development. He could himself see several directions in which there was room for a certain development; but he believed he was speaking without over-sanguineness, and from a due acquaintance with the circumstances, in saying that he looked forward with confidence to the coming of the ideal state of things, when houses would rely upon gas for cooking, warming, and hot-water supply. In fact, with the rapidly increasing adoption of gas-fired steam-boilers and of the gas-heated furnaces to which he had referred, he looked forward to the entire disappearance of the smoke problem—both domestic and industrial.

* See illustration, "JOURNAL," Oct. 13, 1914, p. 75.

Oxidation of Coal during Storage.

From tests made with Philippine coal, as to the rate and amount of oxygen absorbed by coal during storage, Mr. A. J. Cox, in the "Philippine Journal of Science," states that oxygen is first absorbed and that subsequently carbon dioxide is given off. The production of carbon dioxide does not take place simultaneously with the absorption of oxygen. Regarding the calorific value of the pure coal-substance—that is to say, the water and ash-free coal—it was found that in all cases the calorific value is reduced by prolonged storage in contact with air. When coal is stored in the presence of an inert gas (such as carbon dioxide or nitrogen) no deterioration occurs.

MANCHESTER CORPORATION GAS UNDERTAKING

By J. G. Newbigging, M.Inst.C.E.

[A Paper read before Section G of the British Association, Thursday, Sept. 9.]

The brief account of the Manchester Corporation Gas Undertaking, which I have the honour to read to you, is in no sense a paper. It is merely a collection of notes prepared for the purpose of adding interest to the visit which I hope will be paid by some of the members of the Association to the works of this important branch of Manchester's municipal enterprises.

Gas-works were established in Manchester, in the year 1817, by the Commissioners of Police, who were at the time the governing body of the town. In the year 1824 the sanction of Parliament was given to the first Manchester Gas Act, which was also the first legislative recognition that public funds could be utilized for gas-supply purposes. In the year 1843 the powers and the duties of the Commissioners were transferred to the Corporation; and from that time the gas-works became municipal property.

The extent to which the undertaking has grown during the intervening seventy-two years is revealed by an examination of the last published accounts of the department for the year ended March 31, 1915. From these accounts it will be seen that the total value of the works and of the distributing plant, &c., is £3,335,019. Since the year 1843 the sum of £1,884,280 has been placed to sinking fund, out of the revenue of the department, for the repayment of loans. During the same period net profits, amounting to £3,217,174, have been applied to the purposes of the Improvements, Water-Works, and Finance Committees of the Corporation. The price charged for gas in the year 1817 was 14s. per 1000 cubic feet; in the year 1843, 6s. per 1000 cubic feet; and for the year ended March last, 1s. 11·74d. per 1000 cubic feet.

The outstanding debt for the year ended March, 1915, was £1,002,095, or 3s. 5d. per 1000 cubic feet of gas sold, which is the lowest of the larger gas undertakings of the United Kingdom. The output of gas in the year 1844 was 248 million cubic feet; and during the last financial year it reached 6237 million cubic feet, or an annual average increase of 4·75 per cent. The total revenue from all sources last year was £757,167.

As illustrating the extensive character of the undertaking, the works and other properties cover an area of nearly 82 acres, and the distributing mains and service pipes a length of 1440 miles—including 7½ miles of high-pressure mains.

The undertaking has reached its present strong financial position through the Committee having the administration of its affairs not failing continually to avail themselves of up-to-date and economical methods of manufacturing gas. At the same time, regular reductions have been made in the price of gas, and other concessions given to consumers in the shape of free gas-cookers, and low rentals for gas-fires.

Recent Improvements of Plant.

A brief reference to the important features of the works, more particularly recent improvements, will be of interest.

In the first and most important process of gas making—carbonization—the undertaking has occupied a foremost place in the gas industry. Not only was Manchester one of the first to adopt mechanical stoking for charging and discharging retorts, but also constructed one of the earliest installations of inclined retorts, where the charging and discharging are effected by the natural gravitation of the material—thus dispensing with the use of any machinery for the purpose.

The charging of retorts by gravity, and at the same time passing the coal continually through the retorts, instead of charging them at intervals, has always been an ideal of gas engineers; and this has been accomplished by the introduction, within recent years, of retorts set in the vertical position. Many difficulties confronted the use of retorts so constructed; but modern skill and ingenuity have succeeded in overcoming these, and the carbonization of coal in vertical retorts is now an accomplished fact.

Vertical Retort Carbonization.

In this system of carbonization the coal is elevated to the top of the retorts (usually about 23 feet long, and rectangular or oval in section), and passes continuously through, at the rate of 2 to 4 tons per 24 hours. By the time the coal has reached about two-thirds of the distance down the retort, the whole of the gas has been expelled from the coal; and the coke leaves the bottom of the retort in such a cool state that it requires little or no quenching—thus producing a practically dry coke for sale.

The heat in the coke is abstracted before it leaves the retort by passing cold air through fire-clay flues surrounding the base of the retort; and this air, becoming heated, is utilized for the combustion of the producer gases generated from the coke for the heating of the retorts.

The operating advantages of the system as compared with the intermittent are many. Among the more important are: Saving in labour, minimizing of nuisance to the surrounding neighbourhood, and avoidance of loss of gas and other valuable products which necessarily results from periodical opening of the retorts for charging and discharging. A further marked advantage is that the composition and calorific value of the gas flowing from the retorts are uniformly maintained, and yields of gas of 13,000 to 14,000 cubic feet per ton of coal are obtained with a minimum percentage of inert gases in the composition. This uniformity of calorific power and composition is all-important, as Parliament has discarded the luminous test, and now imposes the calorific test on all gas undertakings seeking fresh powers.

Manchester has taken a prominent part in the pioneer work on this system of carbonizing coal, and one of the largest installations in the country has been erected at the Rochdale Road works. It is worth a visit, as illustrating the success which has attended the efforts to advance the carbonization of coal for the production of coal gas in a scientific direction.

The Bradford Road Gasholder and Tank.

At the Bradford Road works a gasholder has been recently constructed of a capacity of 10 million cubic feet; and as it is one of the largest structures of its kind in the world, it is of more than passing interest.

The tank in which the holder floats is 285 feet in diameter, and 43 feet deep. It contains 9,042,018 gallons of water, or 40,366 tons; and 4 million bricks were used in its construction. The floating portion of the holder weighs 1600 tons, and the guide-framing in which the holder works 1480 tons; the framing rising to a height of 170 feet from the ground-level.

High-Pressure Gas Supply.

The distribution of gas at very much higher pressures—equal to that given by a column of water 80 inches high, in place of the ordinary 4 or 6 inches—has come into vogue during recent years, and is becoming increasingly appreciated in Manchester for both lighting and industrial use. We have already 7½ miles of high-pressure steel mains laid in the city; and these are continually being extended. With this higher pressure, the illuminating value of the gas in incandescent lighting is increased two to three fold—due to the better admixture of the air and gas in the bunsen burner, and the concentration of the flame into a small bulk of increased temperature. In certain industrial uses where rapidity of work is essential, it is also found advantageous to use this high-pressure supply.

Projected New Works at Bradford Road.

New works of a capacity of ten million cubic feet of gas per diem have been projected on the Bradford Road site. The plant will include an electrical installation for generating the power required in the manufacturing processes, and the handling of the enormous quantities of coal, coke, and other material. These works should have been commenced this year, but the high interest for loans, the high price of all constructional material, and the restriction of Parliament, have rendered the postponement of the work for a time necessary.

Bye-Products and War Explosives.

The present war has brought gas-works into prominence because coal gas and the bye-products obtained from its manufacture contain substances which either form the basis of valuable explosives or else are used in their manufacture.

Coal tar has hitherto been one of the chief sources of toluene; but since the extraordinary demand for this substance for the manufacture of the high explosive "T.N.T.," attention has been drawn to the fact that the major portion of the toluene produced in the carbonization of coal remains in the gaseous state, and investigations have been made as to the best means of extracting it without unduly reducing the calorific value of the gas. The result has been that simple methods of washing the toluene out of the gas with tar and suitable oils have been devised—afterwards separating the recovered toluene by a process of distillation. Manchester, in common with other large gas undertakings, is doing its share in producing this important munition of war.

It is an unfortunate circumstance that, for a few years before the war, Germany took large quantities of benzol from coke-oven plants in this country—evidently in preparation for the onslaught upon us. We have, therefore, a great deal of leeway to make up for the loss of this valuable residual, at, of course, an enhanced cost to us.

The tendency of Parliament has been to discourage, and even to restrict, gas undertakings desiring greater liberty in the manufacture of bye-products; but to-day under the national emergency they are encouraged to widen their scope, and it is to be hoped that this attitude of Parliament towards gas undertakings will continue after the war. Not only are certain bye-products of gas manufacture necessary in the fight for military supremacy, but there are others equally valuable in the struggle for commercial supremacy.

Utilizing the Residuals.

At our Bradford Road works we have a plant for the manufacture of sulphuric acid from spent oxide, capable of yielding acid of 120° Twaddel, equal to 3700 tons of pure acid per annum. It consists of a set of sixteen five-shelf burners, four chambers, and the usual Glover and Gay-Lussac towers. This acid is used to convert the ammonia recovered as ammoniacal liquor from our four works into sulphate of ammonia; the yearly production being approximately 5000 tons. The plant is arranged in two units, each unit having two combined free and fixed stills, and a closed saturator with self-discharge.

Hitherto the Corporation have left the distillation of tar to private enterprise; but the changes that will be created by the war may render it advisable for this branch of practical chemistry to be widely practised in gas-works, to at least the extent of pro-

ducing the primary products, so as to reduce its bulk and save the cost of transporting the crude tar.

This industry is the pivot upon which other great industries turn—perhaps the most notable being the manufacture of dye-stuffs. Any economic service that gas-works can render to the effort which this country is making to free itself from dependence upon other countries for the supply of this important trade requirement, should be freely given.

Gas Profits and the Rates.

Great as the success of gas enterprise in Manchester has been in the past, it cannot be expected that this will be maintained unless the department is allowed to sell gas at cost price—in other words, relieved from the burden of contributing large sums annually in relief of rates.

The department pays rates and taxes in the ordinary way, like any other trading concern, amounting in the last financial year to £54,885, or 2·23d. per 1000 cubic feet of gas sold. So that the contribution to the relief of rates of a further £50,000, or 2·04d. per 1000 cubic feet, is in a sense a supertax on gas consumers.

Notwithstanding the frequent discussions that have taken place on the question, I am afraid the injurious effect of this policy is not fully realized, and that its continuance is seriously crippling development in a direction which would be most beneficial to the inhabitants and trade of the city. I refer to the displacing of smoky solid fuel with gaseous fuel; this being practically the only direction in which town gas can make any material progress.

It is interesting to recall that Mr. John Shuttleworth, the Chairman of the Gas Committee in 1862, read a paper before this Association at their meeting in Manchester that year. In the course of his remarks, he stated that one of the advantages of the municipalization of the gas-works in Manchester was that the profits—*so called*—could be applied to general purposes. He showed how valuable had been the application of such money to street-making—much needed in Manchester at that time. He also resented the suggestion that gas should be sold at cost price, as in fact had been advocated as far back as the year 1824, and which agitation was the cause of many riotous meetings of citizens.

The conditions of gas supply have, however, so changed since that time, that the question is not now as to whether it is right or wrong that a ratepayer who is not also a gas consumer should receive some return for his assumed liability on the capital expenditure, but the more important one of jeopardizing the prosperity—I almost said existence—of an undertaking on which a sum of over £3,000,000 has been expended.

The advent of the practical application of electricity took away the monopoly which gas previously enjoyed; and it is becoming more and more evident that each of these commodities has, to a very great extent, its separate and distinct sphere of usefulness. I have only to point to the records of the two departments in Manchester in support of this assertion.

Competition between Gas and Electricity.

From statistics I compiled some time ago covering the period 1909-13, I found that the increase in the use of electricity for power purposes over the five years was no less than 155·2 per cent.; and the use of gas for cooking, 30·18 per cent.—these being the directions in which each of these commodities had made the greatest progress. For private lighting, gas was practically stationary, only showing an increase for the same period of 0·2 per cent., and electricity an increase of 7·5 per cent.

The number of cooking and heating appliances supplied to the consumers now totals 134,382—a great impetus being given to the use of cooking-stoves by the abolishing of the charge for hire in the year 1903. This number is apart from those privately owned, of which we have no record. These appliances, including gas-engines, consume 1541 million cubic feet, or 26 per cent. of the gas sold. The Gas Committee only commenced to let out gas-fires on hire in the year 1911; and the number fixed up to the end of the last financial year was 17,083 (included in the above figures). These are estimated to consume no less than 195 million cubic feet of gas per annum.

These figures demonstrate that during the last decade the use of gas for cooking and heating, and industrially, has made good progress in Manchester; but what is wanted is a much lower price than has hitherto been charged, in order to consolidate its position, remove it from merely intermittent to constant use, and encourage its still more general adoption.

Although the field for gaseous fuel is illimitable, its permanent displacement of solid fuel depends mainly on the price at which it is sold, and that there is little difference between the comparative costs of the two fuels for a given purpose.

In the case of a municipality controlling both gas and electricity supplies, there is no reason why the former department should not eventually become the gaseous fuel supplier, and the latter the light supplier.

Gas of a calorific value of 250 to 300 B.Th.U. per cubic foot would be an admirable fuel, and could be cheaply produced. Such a gas could then be freely used in a cheap type of gas-fire which is now made adaptable to existing coal-grates, and hardly distinguishable from a coal-fire.

Gas still required by those who preferred it for lighting and for street lighting would be taken from the high-pressure mains, or even the existing mains at a higher pressure than is now maintained. This lower quality for lighting in an incandescent burner is as efficient at high pressure as a much better quality is at low pressure. For power and industrial purposes it would also be cleaner and superior to any producer gas.

The Fuel Question of National Importance.

Of course, in expressing these opinions I know I shall be condemned as a heretic by those interested in private gas enterprise. Nevertheless the fuel question is of such importance to the nation that it requires to be at once tackled with greater energy than has hitherto been shown. The gas industry has a better opportunity than any other industry of solving this fuel question, and with it the smoke problem, and so placing itself in a stronger position than it now holds.

After the war there will be vast possibilities in the direction of extending the use of gaseous fuel; but unless gas undertakings set their house in order, so that immediate advantage can be taken of the opportunities that will arise, they will, to a great extent, slip from their grasp.

Germany has long since recognized the value of coal gas for industrial purposes as a means of lowering the cost of production in many trades, and so assisting competition with other countries,

Town gas at a low price promotes day consumption, materially helps in the abolition of the smoke nuisance, economizes our coal resources, and broadens the basis of the general prosperity by encouraging the growth of a variety of minor industries whose existence largely depends on the availability of a cheap, cleanly, and handy fuel.

Local authorities in possession of gas-works, with the best interest of their respective communities at heart, should remove all restrictions in the way of selling gas at a low price.

The President (Dr. H. S. Hele-Shaw), in complimenting the author upon having such a fine works, referred to the time when electric lighting was first boomed and all gas shares went down; and he contrasted that position with the present position of gas. Now, owing to the importance to be attached to the bye-products, it was almost essential to produce gas for the sake of the bye-products. At the present moment, it was essential to do so owing to our German enemies in times of peace having taken away from the very heart of this country the essentials that we now required for ourselves. The result was that things which the Germans in their preparations for the war obtained from us very cheaply, we now had to pay very dearly for. He also congratulated the author upon his vertical retorts, which not only tended to the reduction of arduous labour, but were less deleterious to the atmosphere during operations.

Mr. A. W. Oke (a Director of the Southampton Gas Company) joined issue with Mr. Newbigging on the question of selling gas at cost price. John Stuart Mill was right, he thought, when he said that if municipalities owned undertakings of this kind there should be some profit; otherwise it was not a desirable thing. One was inclined to suspect that in some places electricity was sold at a loss by municipalities; otherwise it could not put up such keen competition with gas. In such cases, it was the large shopkeepers who benefited by competition of this kind. Perhaps Mr. Newbigging, in his enthusiasm for gas, slightly overlooked this fact.

Mr. Newbigging, replying, said it appeared to him that gas did not seem to be wholly appreciated. The general public did not apparently know its capabilities or its value as much as they should do. The President had spoken of the early days of electric lighting, when gas shares went down so seriously in value. They certainly did; but to-day he (Mr. Newbigging) ventured to say there was not a sounder investment than in gas undertakings. As to the cost of gas in Manchester, this varied (as elsewhere) with the price of coal, and the amount of the return from residuals. The highest figure he had reached was when the return from residuals was 90 per cent. of the cost of the coal carbonized. At one of the Manchester works gas had been put into the holders at the lowest price gas had ever been manufactured at in this country—viz., 4½d. per 1000 cubic feet. There were in addition, of course, works charges and distribution.

GAS-ENGINE INVESTIGATIONS.

British Association Proceedings.

At last week's meeting in Manchester of the British Association four communications dealing with the subjects of gaseous explosions, gas-engine efficiencies, and gas producers for steam-boilers, engaged the attention of members in Section G.

Gaseous Explosions Committee.

An interim report only of this Committee was presented, winding up with a recommendation that they be again reappointed, and £50 be granted to them for the ensuing session. The Committee consists of Mr. Dugald Clerk, D.Sc. (Chairman), Professor Dalby (Secretary), and Professors W. A. Bone, F. W. Burstall, H. L. Callendar, E. G. Coker, and Harold B. Dixon, Drs. R. T. Glazebrook and J. A. Harker, Colonel H. C. L. Holden, Professors B. Hopkinson and J. E. Petavel, Captain H. Riall Sankey, Professors Arthur Smithells and W. Watson, Mr. D. L. Chapman, and Mr. H. E. Wimperis.

The report points out that, owing to the war, the completion of the equipment of the new laboratories of the Imperial College

of Science and Technology (referred to in the previous report) has been seriously delayed, and the investigation of many problems of importance has had to be postponed. Also, many of the members have been engaged on work for the Government; so that researches on questions under consideration have been either prevented or interrupted. It is not possible, therefore, to present a report to the Association this year. The general work of the Committee, however, has gone on; and during the session three meetings were held, at which the following notes were presented and discussed:—

Note 36, by Dr. J. A. Harker, on "A Method for the Determination of the Specific Heat of the Working Fluid of a Gas-Engine at High Temperatures."

Note 37, by Mr. E. Griffiths and Dr. J. A. Harker, on "A Method for the Determination of the Specific Heat of Gases at High Temperatures."

Note 38, by Dr. Watson, on "The Variation of the Mean Temperature of the Cylinder Contents with the Change of Fuel-Air Ratio for an Engine using Petrol, Benzol, and Alcohol."

Note 36.—At the first meeting of the Committee there was some discussion on the problem of the determination of the specific heat at high temperatures of the working fluid of the gas-engine by some more direct and, if possible, more continuous method than those hitherto employed by members of the Committee; and the object of the note was to suggest a method which might fulfil these requirements.

Note 37 deals with this problem also, and describes a method which has been roughly tested by the authors, and which appears to have important possibilities.

Note 38 is an account of an investigation on the temperatures reached in the cylinder of a small high-speed four-cycle engine using different fuels, accompanied by a figure giving the results of the experiments.

Experimental Investigation of the Thermal Efficiency of a Gas-Engine.

By Professors G. Asakawa and J. E. Petavel.

At the Birmingham meeting of the Association a preliminary note bearing on this subject was read. The investigation has been continued during the last two years, and has led to the conclusions summarized below. The various losses have been separately determined by measurements based not on indicator card readings, but on the rate of change of the kinetic energy of the rotating parts; and thus the errors inherent to the indicator mechanism have been avoided. In the following summary the performance of the engine is compared with that of a perfect engine working on the same cycle with a similar gas mixture.

Indicated Horse Power.—At full load, under the most favourable conditions, the indicated horse-power of a gas-engine is 88 per cent. of that of an ideal engine working with a similar mixture. This holds true for all except very weak mixtures, for which the relative efficiency is lower. For mixtures containing only a slight excess of air, the above corresponds to an absolute thermal efficiency of 27 per cent. at a compression ratio of 3·75 and 33 per cent. at a compression ratio of 5·6; for mixtures containing twice the amount of air required for complete combustion, the absolute efficiencies are 29 per cent. and 36 per cent. The indicated efficiency relative to the gas-standard falls from 88 to 84 per cent. between full and no load.

Brake Horse Power.—At the full load, the brake efficiency relative to the gas-standard varies from 70 per cent. at the compression ratio 3·75, to 67·5 per cent. at the compression ratio 5·6. This holds true for all except the weakest mixtures, for which the relative efficiency is lower. The absolute brake efficiency is 21 per cent. at compression ratio 3·75, 25·5 per cent. at compression ratio 5·6 for mixtures containing little excess of air, and 23 per cent. and 27 per cent. respectively for mixtures containing twice the amount of air required for complete combustion. The maximum brake efficiency obtained in the present experiments was 27·4 per cent. This occurred at the highest compression ratio for a mixture slightly stronger than this. At light loads, the brake efficiency relative to the gas-standard decreases more rapidly as the compression ratio rises. For the higher compression ratios the increase of theoretical efficiency is just counterbalanced by the increase in frictional loss, and thus the absolute efficiency remains constant.

Mechanical Losses.—The mechanical losses increase slightly in absolute amount with the load and with the compression ratio. For the engine under test [a 25 H.P. "National" gas-engine] at normal speed—200 revolutions per minute—the mechanical losses amounted to 5·6 H.P. at no load, and to 6·3 H.P. at full load when the compression ratio is 3·75; and to 6·5 H.P. at no load and 7 H.P. at full load when the compression ratio is 5·6. The pumping losses are an important part of the total mechanical losses. At a compression ratio of 4·85, they represented 2·3 H.P. at no load, and 2·1 H.P. at full load, or 38 and 31 per cent. of the mechanical loss.

Thermal Losses.—The loss of power due to thermal losses at full load under the most favourable conditions amounts to 12 per cent. of the total available energy; and at no load, to 16 per cent. Of this, less than one-quarter is due to heat transmission during the expansion.

A Unit Gas-Producer for Steam-Boilers.

By E. C. Mills.

Gas-fired boilers may be classified roughly thus:

1. The gas a bye-product from plant installed primarily for other purposes.
2. Grouped producers from which the unpurified gas is piped to boilers.
3. Grouped producers with partial or complete purification.
4. Coal-fired furnaces placed externally to the boiler.
5. Unit bituminous gas-producers delivering gases hot and unpurified direct to boiler.

Class 1 gives very cheap steam, as capital charges are debited to other purposes; but it is not applicable to ordinary or average steam plants. Class 2 is only applicable when fuel is extremely cheap. Class 3, when the gas is produced only for steam-boilers. It is only applicable to boilers of the Bonecourt type. Class 4. This is hardly a gas-producer at all, but is named because many attempts have been made in this direction. It fails mainly by reason of the destruction of the brickwork under the intense heat. Class 5. In this class is the Mills furnace.

All the above, as compared with the ordinary internal fire, have the advantage of not arresting the combustion process by temperature reduction through contact with water-cooled plates.

Single gas-producers for metallurgical furnaces are well known and successful.

The aims of the inventor of the Mills furnace were:

1. It should not be too costly.
2. It must utilize the radiant heat of combustion.
3. There must be ample temperature to endure complete chemical combinations.
4. Access to the boiler for examination and repairs must not be hindered.
5. The whole of the various gases given off by the fuel must be immediately burnt with their sensible heat of production in them.
6. Little or no excess air must be used.
7. All ordinary qualities of coal must be usable.
8. Attendance must not be excessive.

Dealing first with No. 6 (above), the usual allowance of excess air is absolutely necessary in the burning of fuel in solid or lump form, by reason mainly of the mechanical difficulty of bringing each part of oxygen into intimate contact with its concomitant part of carbon or hydrogen at the right time and in the right place. To do this in a metal water-surrounded box is quite an impossibility.

Slides showing outside, inside, and sectional views of the Mills producer were shown by the author. By means of slides, and examples and models of various parts, he was also able to indicate: (1) The action and control of the induced draught giving the separate air supplies for gas production and its combustion; (2) the cellular construction of the roof and walls by which air for combustion is heated by the otherwise lost radiant heat of the producer; (3) the means of withdrawing the whole to allow access to the boiler front; (4) the special design of firebrick gas and air mixing device and burner; (5) the self-cleaning sight-hole appliance; (6) the automatic fuel-feed; (7) the arrangements for clinker-extraction; (8) the flue-gas interceptors introduced; and (9) other details of construction.

The results of tests on a Cornish boiler, worked on an ordinary internal fire and with the Mills producer, with the same fuel in each case, and tested by the same expert, were detailed to show a saving of about 50 per cent.; and there was no smoke. Tests on a Lancashire boiler with the Mills producer were said to give high efficiencies and standardized evaporations ranging from 10·23 lbs. to 11·47 lbs. of steam from 1 lb. of coal; while on a comparison with another boiler fired with the same fuel but with the ordinary internal fire, the tests showed a saving of about 18 per cent. in evaporation. In this case also there was an entire absence of smoke.

The Total Radiation from a Gaseous Explosion.

By Dr. W. M. Thornton.

In a short communication, the author said that the argument by which the lost pressure or suppressed heat of a gaseous explosion is made to depend upon the mechanics of two colliding and cohering spheres may be extended to the case of radiation. The problem was dealt with by him in the "Philosophical Magazine" for September on the following lines. Consider two atoms of equal mass m, approaching one another with equal velocity v, and having equal rotational and translational energies. The total energy of translation before collision is mv^2; the rotational energy, Iw^2. The vibrational energy may be taken as zero at the moment before contact—for radiation is not important until there is chemical combination. The total loss of translational energy on collision, which is equal in the case considered to $\frac{1}{2}mv^2$, is shared between rotation and vibration. If equally shared, the rotational term gains by $\frac{1}{4}mv^2$, the vibration is established, within or between atoms, having also energy of $\frac{1}{4}mv^2$. The total radiation under these elementary conditions should therefore be 25 per cent. of the energy of combination—that is, of combustion.

A complete theory of explosion must account for both the suppressed heat (found experimentally to be half that of combustion) and the energy radiated, which has been observed by Hopkinson and David to be 22 per cent. of the heat of combustion. In the

theoretical case of two equal colliding spheres, these are respectively 50 per cent. and 25 per cent. of it. This simple conception, therefore, appears to be capable of explaining these two very important features of gaseous explosion. No reason, *à priori*, has been given for the radiation to be expected; and it is generally agreed that specific heats do not vary sufficiently to account for the loss of the pressure.

According to this mechanical view, an explosion may be regarded as: (1) A process such as ionization by collision causing a loosening of the bonds of the molecule of combustible gas and of the oxygen molecule; (2) attraction between ionized oxygen and combustible gas atoms resulting in a violent rush together, the total translational energy of which is the heat of combustion; (3) formation of products of combustion having a mean translational energy one-half of that of the combining atoms, mean additional rotational energy $\frac{1}{4}$, and vibrational energy $\frac{1}{4}$ of it.

The interchange of energy between (say) rotation and vibration appears to be slower than between translation and rotation; for the pressure is instantly checked on rising, while radiation up to the time of maximum pressure is only 3 per cent. of the total heat of combustion. While the pressure remains nearly constant, the gas continues to radiate; and it is, therefore, in the absence of prolonged combustion receiving energy from the remaining degree of freedom—*i.e.*, rotation. Any excess of rotational energy is shared between the other two terms; and in the process suggested there should be both persistence of pressure and of radiation.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by Correspondents.*]

Dividends.

Sir,—At an ordinary general meeting of a company, recently held and reported in your columns, an incident occurred which seems to invite further attention.

From your report of the proceedings, it appears that, in proposing the adoption of the Directors' report, the Chairman said:

> "Heretofore the Directors had recommended a dividend free of income-tax; but, if they were to keep the rate to the previous level of 5 per cent., they would be obliged in future to deduct the income-tax. No one could have seen that the income-tax was going to jump in the way it had; and it was only right that it should be brought to the notice of the shareholders that it would be impossible to pay the dividend free of income-tax. If this was done, the dividend would probably be 4½ instead of 5 per cent."

After the report had been adopted, a shareholder proposed the dividend named in the report—5 per cent.—free of income-tax; and this was duly seconded and carried.

It seems not to be so generally known as would be desirable that, unless specially authorized by the Private Act or the Articles of Association of the Company, an amendment to increase the amount of the dividend recommended by the Board of Directors is *ultra vires*. In regard to companies working under the provisions of the Companies (Consolidation) Act, 1908, section 95 of Table "A" enacts that: "The company, in general meeting, may declare dividends; *but no dividend shall exceed the amount recommended by the directors*." In regard to companies incorporating the Companies Clauses Acts, section 120 of the Act of 1845 enacts that: "Previously to every ordinary general meeting at which a dividend is intended to be declared, the directors shall cause a scheme to be prepared showing the profits, if any, of the company for the period current since the preceding ordinary meeting at which a dividend was declared, and apportioning the same or *so much thereof as they may consider applicable to the purposes of dividend*, among the shareholders. . . . and shall exhibit such scheme at such ordinary meeting and at such meeting a dividend may be declared *according to such scheme*."

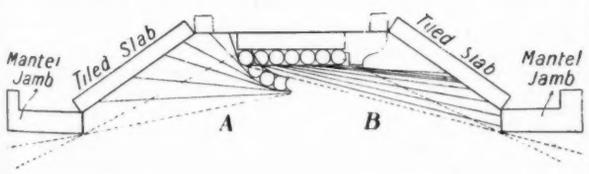
H. D. Ellis.

London, Sept. 9, 1915.

Radiant Heat Distribution.

Sir,—I have to thank you for your complimentary remarks in commenting upon my letter on radiant heat distribution.

Once again you state as the primary object of the new design that it is to increase the field of radiant heat distribution. This I have not contested. My point is that, assuming the same amount of radiant heat from a given consumption of gas, the increase in distribution area will obviously afford a less amount of heat at some other point, as compared with a straight front. Further, there would actually be a serious loss



of heat by radiation into the fireplace. The enclosed sketch clearly shows this; the sideways limit of the radiating lines of the respective fires being indicated by lines, the usable by dotted lines—half section "A" representing a circular, and half section "B" a straight front. The tiled slab and mantel jamb on "A" side will receive, of course, a great amount of radiation in addition to the sideways indicated.

With regard to the secondary object of additional appreciation by the user, this is hypothetical, and does not arise out of the criticism I ventured to put forward, which dealt with scientific facts, and not with questions of taste. You cannot eat your cake and have it; neither can you increase the radiation distribution area, unless the gas consumption is also increased to make good the losses in the direction in which radiation has hitherto been regarded most useful.

The increased area achieved by altering the design is of little practical use in room heating with the big majority of modern room fixtures. You state that the semi-circular fronted fire carries the effective lines further back; yet you say you do not think anyone would want to sit there. I agree.

Exception must be taken to your statement that the round-fronted fire is a new kind of fuel placement. I have not overlooked the fact that from a round-fronted fire you will get radiation directly in front of it; but I repeat you must have a larger fire area, and therefore a larger consumption of gas, to get in the usable part of the room the same amount of heat as you get from the straight-fronted fire.

In speaking of side draughts, I do not imply merely those created by air inlets and outlets, but also the draught set up by persons passing across in front of the fire. It is astonishing what little air movement is required to bring out the products.

Jas. W. Wilson
(Wilsons and Mathiesons, Limited).

Leeds, Sept. 11, 1915.

[Mr. Wilson's present letter (which came to hand just as we were preparing for press) is perhaps even more interesting than the one published last week. It is pleasing to find that we are on common ground in agreeing that the new design of fire ("new design" taken as a whole, and not in part) will increase the distribution of the radiant heat. He says he does not contest this. His main contention, as now stated in precise terms, is that, "assuming the same amount of radiant heat from a given consumption of gas, an increase in distribution area will obviously afford a less amount of heat *at some other point*, as compared with a straight front." Then we may put the converse proposition: With a straight-faced fire, the radiant heat, with the same consumption of gas, will be less at certain points and more at another point than with the semi-circular fire. That is the corollary of Mr. Wilson's proposition. The real question is which is the best distribution for practical purposes—the more concentrated or the more distributed radiant heat. Every part of a room should be "usable;" not a certain part only. With some fires and in some rooms, it would be a decided advantage to reduce the frontal heat somewhat, and send it in other directions. Whether the fire has semi-circular or straight-line fuel placement, the amount of heat sent into the room is the same; it is only a question of its more equable distribution by the one fuel disposition than the other. There is the point, too, that, as constructed, the semi-circular fire in question will, we believe, show a radiant efficiency somewhat in excess of what the makers have shown with a straight-fronted fire, and they have not hitherto been behind the best attained standards in this respect. This we think will be admitted even by their trade rivals. Mr. Wilson sends a sketch with his letter showing the semi-circular fronted fire in a recessed fireplace, to illustrate the absorption of some of the radiated heat by the side tiling. If our correspondent will look at the top illustration on p. 445, he will see that the idea is to use the fire for straight filled-in mantels, and not recessed ones. Then Mr. Wilson remarks: "You state that the semi-circular fronted fire carries the effective lines further back; yet you do not think anyone would want to sit there." That is a perversion of our statement, which was (top of p. 494): "No sitter, Mr. Wilson also says, would wish to be *behind* the line of effective radiation. Certainly not; and the semi-circular fire carries the effective line further back." Which we fancy will be interpreted by most readers as meaning that the sitter could go farther back with the semi-circular fuel placement before getting "*behind* the line of effective radiation." With regard to draughts, it is unnecessary to repeat the observations that were made last week (p. 494). The modern fires with which we are practically acquainted do not give any inconvenience by their flames and the current of products of combustion being unduly sensitive, though installed in all sorts and conditions of rooms, in which people are freely moving about.—Ed. J.G.L.].

Alliance and Dublin Consumers' Gas Company.

Sir,—I am sure a silent prayer was offered up by many of your readers interested in the above, on seeing your correspondent "Anticipant's" letter in last week's issue. He voiced hopes, present and future, which all the shareholders will heartily echo. These are days when we want all the optimism we can get hold of; and I would be the last one to call up any little cloud on the horizon to darken the outlook. But it is essential our optimism should be genuine.

Your correspondent builds his castle of financial possibilities from the table set forth of the gross profits of the Company for the years 1910 to 1914 inclusive, and summarizes the matter in the words, "The tide has again turned." That it has apparently turned, the severest

critic, I think, will quite admit; but that there was ample room for the returning sweep to be made will also be admitted by all concerned. In short, the low-water mark reached in 1913 was a very low one indeed. I do not agree, however, that we can read into the figures for 1914 the fact that we are in the swing of the high tide under the full moon of prosperity.

In your issue of March 30, 1915—following the receipt of the Directors' report and statement of accounts for the half year ended Dec. 31, 1914—appeared from me a letter pointing out fully my reasons for a chastened enthusiasm; and I would refer your correspondent "Anticipant" to what was there set out in a genuine desire to gauge the situation broadly and fairly. I showed then that, working on the basis of previous half years, and taking cognizance of past practice (wise or unwise) the gross profit for the half year suffered a very serious reduction. To be concrete, we got a comparative figure of £24,619, instead of £53,111. I invited the Directors' comments; but none have been forthcoming, and naturally, initial optimism received a decided set-back. I further pointed out the decrease in the sales of gas by some 4 per cent., as compared with the corresponding half year ending 1913, and also referred to the very high percentage (12¼ per cent.) of unaccounted-for gas. All round, after close scrutiny of the printed accounts—the only source of information available—very much of the brightness of the outlook disappeared. I have not yet received a copy of the report and accounts for the half year just ended; but if they follow the lines of those above criticized, we will be indulging very much in the dark any feelings of satisfaction that first glances may give us.

One cannot help thinking there is something mysterious about the workings of the concern since the upshot which ended in the new constitution of the Board some fifteen months ago. We have all waited with the patience becoming a Job for the experts' report on which "Anticipant" lays so much stress. And rightly so; the dark is ever disconcerting and pregnant with imaginings and forebodings. Why have we been kept so long in the dark? It is not conducive to optimism—very much the reverse. The prime movers (*) in the original intention to have the Company's affairs thoroughly sifted and daylight admitted, so that the shareholders could judge for themselves, are now members of the new Board, which makes silence more significant. The infusion of new blood on the Board was a vitally necessary step; and the introduction of a Consulting Engineer and Consulting Accountants of high standing was procedure that one and all welcomed. But surely ample time has elapsed for a full pronouncement as to their labours and policy to have been forthcoming. If it is not to be given at the coming meeting, then it will be high time to appoint a committee of shareholders with definite powers to "get a move on" (to use a colloquialism). Otherwise such good as may have in reality been achieved by the "powers that be" will be largely negatived.

It is idle to applaud until the curtain that has been kept so long down has been rung-up. The three English Directors who were appointed have likely, at much personal sacrifice, rendered worthy yeoman service to the concern; and no doubt appreciation will be voiced. But it is impossible to pay definite tribute while we are still in the dark as to all that has been attempted, all that has been accomplished in the interests of the Company and of shareholders on both sides of the water. "Many hands make light work;" and, with the expert assistance now available, trials and difficulties should be fast declining, and the Company well on that road which leads to permanent security and welcome prosperity. I shall hope to hear so, point blank, on an early occasion.

R. W. EDWARDS ["NONULUS"].

Aldershot, Sept. 9, 1915.

* P.S.—The writer, as "Nonulus," long preceded others in agitative interest in the Company's affairs, as past numbers of the "JOURNAL" show. But since Mr. F. J. Dickens's circular of Sept. 27, 1913, he has been content to mark-time and observe a patient neutrality. This circular made two definite promises

(*a*) To send a copy of Mr. William Newbigging's report.
(*b*) Dependent on the nature of the report, to call the shareholders together to consult on the situation.

Nothing further occurred until March 16, 1914, when Mr. Dickens issued a further circular-letter, stating that his expert's report—that is, Mr. Newbigging's—had become a joint experts' report, blessed and paid for by the Company; and that its contents were not to be revealed to the shareholders. Now this did not at all absolve Mr. Dickens from his promise (*a*); and as was clearly evident from the experts' expression voiced in the second circular-letter—namely "unsatisfactory as our report indicates the position to be to-day, it is not past remedy"—there were emphatic grounds why promise (*b*) should also have been fulfilled, and the shareholders called together. In short, the report was of such a nature calling for "independent action," but, instead of Mr. Dickens making it his duty (as he promised) to hold a meeting to consult on the situation, he and two friends were nominated to the Board, and nothing further has happened. It would look, therefore, as if advantage had been taken of those who, deeply interested in the Company's welfare, stayed criticism on trust and "sang dumb" under the spell of hopes which have gone unfulfilled. In this connection the general body of the shareholders have a distinct grievance.—R.W.E.

Plea for Economy.—The question of discontinuing public lighting during the coming winter was recently discussed at a meeting of the Bletchingley Parish Council. Mr. Martin, who put forward the proposition, urged that they ought, if possible, to save a little. They were justified in taking this step, because he did not think public lighting was required under existing circumstances. In these times there were not many people about late at night. Mr. Bashford did not believe they would be doing the right thing in abandoning public lighting. Mr. Kent said he agreed with Mr. Martin on the matter of economy; but it was a question whether they did not get more out of the penny rate for lighting than anything else. The Chairman suggested that consideration of the subject should be postponed till the next meeting, in order that the decision of a full Council might be taken. It was decided to adopt this course.

REGISTER OF PATENTS.

Gas-Burners and Gas-Rings.

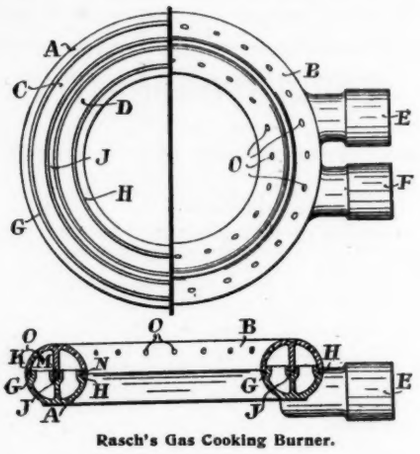
RASCH, L., of South Norwood, S.E.

No. 12,036; May 15, 1914.

This invention relates to gas-burners for cooking purposes of the type in which gas issues from orifices in a burner or ring, the upper part of which is detachable for cleaning.

It has previously been proposed to provide (according to the patentee): (1) A gas-ring of the type set forth with vertical transverse partitions to divide the ring into compartments, each provided with a separate gas supply. (2) A gas-ring with a horizontal partition to form two separate passages, each with a separate gas supply—in this case ready access for cleaning is not provided. (3) A straight, perforated tube burner divided by a vertical diaphragm into separate parallel passages, each provided with a separate gas supply—the burner in this case not being divisible into upper and lower parts.

According to his invention, the burner or ring comprises a perforated tube provided with vertical ribs or diaphragms which divide the tube into separate parallel gas-passages—as shown in the engraving. The right-hand half shows one form of the burner or ring; while the left-hand half shows the detachable member removed. There is also a cross section.



Rasch's Gas Cooking Burner.

A is the fixed member and B the detachable member of the burner. There are two gas-passages C D with independent connections E F for gas supply. The fixed member is provided with annular recesses G H at the outer and inner peripheries of the ring and an annular groove J. The detachable member is formed with depending flanges K, M, N, adapted to engage with recesses and groove G, H, J. O are two independent sets of orifices in the detachable ring through which the gas passes.

Should the jets get stopped up by charred food or other material which eventually finds its way into the gas-passages, they are readily cleaned by removing the detachable member to obtain access to the interior of the ring.

Peat Gasification.

RIGBY, T., of Dumfries, and WETCARBONIZING LIMITED, of Dean Farrar Street, Westminster.

No. 16,918; July 16, 1914.

This invention, relating to the gasification of peat with recovery of bye-products, has particular reference to the utilization of wet carbonized peat, as referred to in patents No. 10,834 of 1903 and No. 17,610 of 1911.

The patentees remark that in the gasification of fuels such as coal in bye-product recovery gas plant—for instance, of the Mond type—provided a sufficient proportion of steam is introduced into the producer, no difficulty is experienced in securing a gas of steady calorific value, and in maintaining efficient bye-product recovery despite considerable changes in the condition of the fuel fed into the producer, and especially as regards changes in moistness such as occur in materials like colliery refuse.

They claim to have ascertained that different conditions present themselves in the gasification of peat, and that to secure constancy in gas composition and maintain efficient bye-product recovery the fuel entering the producer must be maintained as far as possible in the same condition, and, in particular, a steady moisture content must as far as possible be maintained. This difference in behaviour between coal and peat must, they say, presumably be attributed to the difference in the volatile matters present in the respective fuels.

The present invention consists in a method of gasifying (with bye-product recovery) peat fuel in different conditions, and especially as regards moisture content, in which the average condition of the fuel entering the gas-producer is maintained, as far as convenient, constant by controlled proportionate admixture of the different grades of the fuel. It is more particularly a method like that described for gasifying mixtures of briquetted peat and press cakes of peat as are described in the 1911 patent mentioned above, according to which the admixture is effected by automatically measuring out, preferably in a continuous manner, for admixture, the two forms of the fuel in predetermined proportion variable with the respective moisture content, and thereafter thoroughly admixing (also preferably in a continuous manner) the measured-out quantities.

Locking and Closing the Casings of Tar Separator Plunger Bells.

BERLIN-ANHALTISCHE MASCHINENBAU-AKTIEN-GESELLSCHAFT, of Dessau, Germany.

No. 17,180; July 20, 1914. Convention date, Dec. 19, 1913.

This invention relates to the lever-operated locking and closing devices for securing the removable casings or walls of tar-separator plunger bells on much the same lines as those described and illustrated in the Company's patent No. 16,981—see *ante*, p. 522.

The claims made for the invention include: The combination with the casing of a tar-separator plunger bell of a lever-operated locking and closing device, characterized by one of the two parts forming a toggle-joint and pivoted to the members it is desired to connect—thereby being made adjustable relatively to its corresponding part; a set-screw pivoted to one of the two parts it is desired to connect together; a handle, which can be locked by means of a lock-nut, adjustably mounted on this set-screw; and a yoke or shackle pivoted to the other part, and adapted to engage a notch or the like formed on the handle.

Distillation of Carbonaceous Material.

HILLS, H. G., of Manchester, and THOM, R. W., of Southport.

No. 18,576; Aug. 12, 1914.

Many attempts have been made, the patentees mention in their specification, to produce from carbonaceous and bituminous material smokeless fuel which would be suitable either for industrial or domestic purposes. The desire naturally has been to use the cheapest material, which in England is the dust produced in raising bituminous fuel.

In their first efforts to accomplish this purpose they were met with "various difficulties, many of which have been undoubtedly also experienced by others." For example, it has been found impossible in some systems to use fine dust, as the volatile matter could not be drawn off, and also because the dust of some kinds of bituminous fuel (non-caking coal) could not be made to adhere. In other systems there has been difficulty in removing the coke from the retorts, so that it has been broken up in the process. Again, in the production of coke from dust, there is a tendency for the coke to be of a very light fragile nature, so that it takes up a great deal of space, and in transit gets broken into dust.

Their present process consists in the introduction of the material without agglutinants and in a movable container into a vacuum chamber; transferring it thence into a distilling chamber or chambers, where the material is distilled at a temperature below (or but slightly exceeding) the temperature at which tar is formed, from which chambers it is passed in a plastic condition into a cooling chamber, where it may be subjected (if required) while still plastic, to the degree of pressure necessary to produce fuel of the desired density.

They say they have found that bituminous fuel, even of a non-caking quality, can be converted into sound coke if the distillation is carried on within certain limits of temperature—generally between 500° and 700° Fahr.; also, that the volatile matter which causes smoke is produced at temperatures usually below 700° Fahr.; and that below this figure tar and permanent gas are not produced except in negligible quantities.

Their investigation and experiments also show that this volatile matter can be expelled even from powdered coal at the temperature named, if the fuel is submitted to distillation in comparatively thin layers in a convenient form. It has further been demonstrated that coal in a powdered condition makes much firmer and more regular coke than does coal in lumps. They find that it frequently happens that coal at the temperature mentioned is in a perfectly plastic state, whereas at a higher temperature it crumbles to dust. When in a plastic state coal can, it is found, be compressed into firm, dense fuel.

Having ascertained and demonstrated these facts, they devised a complete process and apparatus for putting them into practical use, the following features of which are important: Air must be excluded during the process of distillation; to get the best effect the distillation must be carried on under a slight degree of vacuum; the fuel being treated should be in flat receptacles, divided into compartments to produce the desired size of block; the retort should be heated externally—the heat being so controlled that the temperature can be varied along its length; the retort should have ascension-pipes to draw off the vapour at different points along its length, so that the vapour produced at different temperatures can be collected separately; there should be a chamber anterior to the retort (but connected with it), so that the receptacles containing the fuel can be introduced into this anterior chamber, a vacuum be produced therein, and then a door be opened between the chamber and the distilling chamber into which the receptacles would be at once transferred; at the end of the retort there must be a similar chamber for cooling purposes—the receptacles containing hot plastic fuel being passed into it when the distillation is completed; the plant for compressing the plastic fuel is preferably placed in this cooling chamber; and before the hot fuel is introduced into the cooling chamber a partial vacuum should be created or inert gases introduced—thus preventing explosions in the retort or the necessity to quench the fuel with water.

A suitable arrangement of plant for the purpose is substantially that which is described and illustrated in their patent No. 3284 of 1913—see "JOURNAL," Feb. 24, 1914, p. 517.

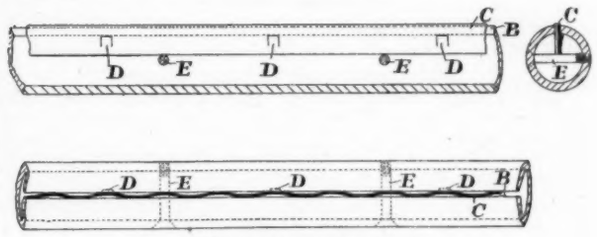
Gas-Burners.

KEITH, J. & G., of Farringdon Avenue, E.C.

No. 22,762; Nov. 19, 1914.

These gas-burners, fed with a self-burning mixture, are adapted for use in heating chambers of considerable longitudinal dimensions—*e.g.*, biscuit-making ovens.

The burners are formed of a fine saw-cut, and fitted diametrically of the cross section of the tube are a number of spacing or bridging members formed by screw-threaded pins entering corresponding apertures in the walls of the tube. These pins serve to stiffen the tube against springing action when the sawing operation is being effected and subsequently. The metallic strip serves to preheat the gaseous mixture, and also, "owing to its larger area exposed to the mixture, to protect its outside edges from becoming overheated, and so reduce any tendency to light-back."



Keith's Gas-Heating Burners.

A plan is given of one form of burner according to the invention, with cross and longitudinal sections.

The tube is formed with a longitudinal saw-cut B in which is inserted a crimped or corrugated metallic strip C formed with tongues D struck out from the body of the strip. Screw-threaded pins E are disposed diametrically of the tube perpendicularly to the plane of the cut. To permit the insertion of the strip the screws will be adjusted to permit the cut to gape slightly; the strip being inserted so far that its inner edge abuts against the pins. Thereupon the pins will be readjusted to clamp the strip in position with the free ends of the tongues engaging the inner wall of the tube—the strip being thus restrained against movement radially of the tube.

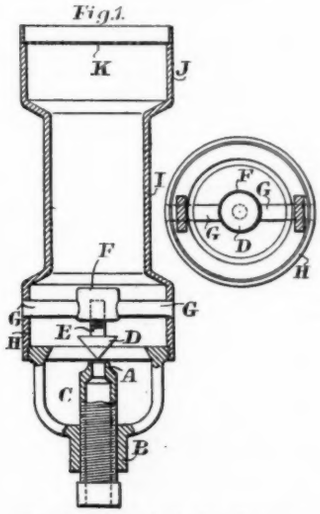
Atmospheric Burners.

EWART, J. W., of Mill Hill, N.W.

No. 23,734; Dec. 8, 1914.

These atmospheric burners are of the kind in which there is provided, in conjunction with the nipple through which the gas issues into the air-inlet space at the end of the mixing-chamber, a spreading device arranged so that the jet impinges upon it and is spread or distributed into the mixing-chamber, and "thereby caused more intimately to mix with the air which is drawn in around the gas-jet—the result of such intimate mixture being a more perfect combustion of the gas."

Fig.1.



Ewart's Atmospheric Gas-Burner.

Referring to the construction illustrated, A is the gas-nipple, which is externally screw-threaded and engages in a screw-threaded hole in a head B provided on the lower part of the air-inlet space C, so that, by turning the nipple, its position relatively to the air-inlet chamber can be adjusted. D is an inverted cone furnished with a screw-threaded shank E, by means of which it can be adjustably secured in a boss F supported by arms G in the lower part H of the mixing-chamber. The upper end of the mixing-chamber is connected to the lower end of the burner tube I, which is of smaller diameter than H and is expanded at its upper end so as to form the part J, the diameter of which is the same as that of the lower part H. K is a gauze disc supported on a shoulder a short distance from the top end of the burner tube.

The cone D is arranged with its apex in the axial line of the gas-nipple, so that as the gas-jet issues from the nipple it impinges axially upon the apex of the cone, and is consequently split-up or scattered "so as entirely to permeate the whole of the burner mixing-tube." The gas distributed in this way is said to very intimately mix with the air drawn into the air-inlet chamber C in the usual way "whereby a complete combustion of the gas takes place, with the result that the capacity of a burner can be materially increased as compared with burners in which no effective distribution of the gas is effected."

MISCELLANEOUS NEWS.

MELBOURNE METROPOLITAN GAS COMPANY.

Half-Yearly Meeting.

The Half-Yearly Meeting of the Company was held at the offices in Melbourne on July 28—Mr. JOHN GRICE (the Chairman) presiding.

THE REPORT AND BALANCE-SHEET.

The CHAIRMAN, dealing with the report and balance-sheet, said: The sales of gas for the half year reached a total of 1466 million cubic feet, against 1350 millions for the June half of 1914—an increase of 8½ per cent. Turning to past records, you will see that the output for the past six months equalled approximately our total output for the year 1907. The revenue from sales of gas by meter and public lighting amounted to £314,595, as compared with £289,699 for the corresponding period of last year. From the sales of residuals we obtained a revenue of £71,624, as against £72,126 for June, 1914. The demand for tar, particularly for road-making purposes, has greatly increased during the last few years, and at times it has been found difficult, and sometimes impossible, to supply the requirements during the summer season. Owing to the withdrawal of Continental supplies from the sulphate of ammonia market, the price of this commodity (which had been falling) has appreciated since the commencement of the year, and the prospects in the immediate future are favourable. Owing to increased business, you will find corresponding increases on the expenditure side of the account. The item of repairs at works, £41,538, needs to be specially mentioned. This amount compares with £41,088 for the June half of 1914; but in the latter figure was included £10,000 as a special provision for renewals, to which I called your attention at the time. The amount for this half year represents expenditure which has actually taken place in that period. The Directors are impressed with the necessity of keeping the plant in perfect order, and thereby not only increasing its efficiency, but providing a margin in case either of sudden demands or of a contingency of some kind. We are informed by our Engineer that large expenditure under this heading must continue in succeeding half years for some time yet.

CONTRIBUTIONS TO FUNDS.

Following the expenditure side of the balance-sheet down, we come to contributions to Belgian and Victorian Red Cross Australian sick and wounded funds. A sum of £500 was given to the Belgians, and £2000 to the Australian sick and wounded funds. Though the Directors know perfectly well you will approve of such gifts, and by your adoption of the balance-sheet to-day would confirm their action, they have drawn special attention to them in the report, so that you can clearly understand that by its adoption you not only approve of what has already been done, but you authorize the Directors to act in their discretion in supporting such relief or patriotic funds in the future.

EMPLOYEES ON ACTIVE SERVICE.

Following upon the lines of policy we had adopted prior to our last meeting, we are continuing, until further notice, to undertake to make up to those of our employees enlisting (after twelve months in our service), or their dependants, the difference between the military pay and the rate they were receiving in the employment of the Company. We are also promising to reinstate these men in our service on their return from the war. Up to now no fewer than 170 employees have offered themselves for service in the defence of their country. At the same time, we have notified the fact that during the continuance of the war we do not intend to engage any fresh applicant for adult employment who is unmarried and who is eligible for enlistment. Our next half-year's payment to those who have already volunteered will amount approximately to £1700. We have to record, with regret, the death on active service of three of our employees, and that one has been wounded. A charge of £1042, half-year's premium for insurance which the Company has to pay under the Victorian Workers' Compensation Act, appears for the first time in this balance-sheet as an item of expenditure.

DOMESTIC AND INDUSTRIAL GAS APPLIANCES.

The total number of meters in use at June 30 was 142,858 (including 26,263 slots). At the same date in 1914 the total was 135,937. The recent lessened activity in the building trade is reflected to some extent in the business of our stove department for the past half year; but, notwithstanding this, we have increased the number of stoves in use during the period by 3203—the increase for 1914 was 4400—showing that in houses already erected gas-stoves are being substituted for other methods of cooking. Under present conditions I think we may regard the result as not unsatisfactory. Of bath-heaters, we sold 626, compared with 512 in the June half of 1914. As the result of special efforts to impress upon our consumers the many advantages of gas-fires in place of other forms of heating, we have disposed of no fewer than 2325, as compared with 1538 in June last year—an increase of over 50 per cent. It is gratifying also to record the fact that a large proportion of our business in this particular line has been derived from consumers who previously having had experience with one fire have decided this winter to further extend the use of this labour-saving appliance in their homes. We have sold 190 gas wash-coppers, and fixed 100 burners under existing coppers. Builders and architects are now both advocating the use of these appliances, not only for cottage properties, but for large residences and flats. We have sold 2292 gas-irons during the half year; and their use is extending freely. Grillers and boiling burners, together with special appliances, have sold to the number of 1139. Our lady stove instructors have visited 6496 stove users during the half year; and much assistance has been afforded by them to consumers, who are thereby enabled to obtain the most economical results from gas-cookers. There is a growing demand for the use of gas for industrial purposes, and gas under air pressure has been installed in the premises of a certain number of manufacturers. As demonstrating the appreciation by the public of gas appliances, it might be mentioned that in one large building now being erected in the city for residential flats and professional chambers, we have obtained a contract for installing 22 circulating water-heaters, 22 cooking-stoves, 79 lavatory heaters, and 138 gas-fires. We are extending the use of gas also for high-pressure lighting. One large recently erected factory has been fitted up under this system, and we have also succeeded in introducing it during the half year for the purpose of railway station lighting at St. Kilda. This form of lighting is especially suitable for external illumination; and an installation which was fitted up by this Company at a picture theatre some few months ago has proved particularly attractive and effective, and has given complete satisfaction to the proprietor of the building.

EXTENSIONS.

Of mains we have laid a total length of nearly 27 miles, and 55 miles of services have been put down in the last six months. It has again been found necessary, in order to strengthen the supply in the growing outlying districts, and to secure an efficient gas circulation, to lay several trunk mains. To place the Company in a position to meet the increasing demands made upon us, you were advised twelve months ago that a contract had been placed for the erection of a large vertical retort-house at West Melbourne on the Woodall-Duckham design. The whole of the material for this work has been delivered in Melbourne, and rapid progress is being made in the erection of the house.

ADDITIONAL CAPITAL.

At an extraordinary general meeting of shareholders of the Company held on June 30 last authority was given to the Directors to create and issue 10,000 additional new shares for the extension of works and other purposes of the undertaking, and to borrow £50,000 upon debentures. Acting upon this authority, the shares were sold by public auction. After careful consideration of the whole position, and in view of the condition of the Money Market at the time, we fixed an upset price of £9 10s. per share. The whole issue was disposed of at prices averaging £9 11s. 4½d. per share. The Directors regard the result as satisfactory, having in view the disturbed condition of the financial world at the present moment. Had we been in a position to have sold these shares at the date when permission to issue them was granted by the shareholders, higher prices would have been realized.

AN EMPLOYEE-SHAREHOLDER'S REMARKS.

Mr. EDWIN PHILLIPS, in seconding the motion for the adoption of the report and balance-sheet, referred to the stability of the Company's business, and the favourable comparison which the management made with that of other gas concerns.

Mr. H. J. TAIT, who supported the motion, said he was present in a dual capacity; being both a shareholder and employee of the Company. He could assure shareholders that the manner in which the employees were being treated by the Directors was very gratifying, and much appreciated by the workmen as a whole. He would like to suggest that the Directors should obtain a group photograph of the employees who had enlisted, which could be kept as a memento of the occasion. The members of the Employees' Association had every confidence in the security of the Company. Last week the Association had secured a further 230 shares in the Company, and now held 710 in all, which cost them £7011. His Association would like the Directors to assist employees who might have suggestions or inventions which might be to the benefit of the industry. The annual leave of six clear days granted to employees was fully appreciated. There were now 1000 members of the Gas Employees' Association.

The CHAIRMAN, in replying to Mr. Tait, thanked him for the suggestion of a group photograph. The Manager, Mr. Hinde, informed him that the matter was already in hand. For many years the Company had had arrangements for receiving the suggestions of employees which might lead to inventions; but apparently in those days the staff was not very inventive, for the matter had to be given up. The Directors would, however, be only too glad to receive suggestions or inventions. He was glad that the workers were so interested in the Company. The scheme was like the co-partnership in English gas companies.

THE DIVIDEND.

The motion for the adoption of the report and balance-sheet was agreed to, and a dividend of 6s. 6d. per share out of the profits for the half year ended June 30 was declared.

VOTES OF THANKS.

The meeting concluded with a hearty vote of thanks to the directorate and staff, to which the Chairman, the Secretary and Manager (Mr. John Hinde), and the Engineer (Mr. J. W. Reeson) responded.

ILFORD GAS COMPANY.

The Half-Yearly Meeting of the Company was held at Ilford, yesterday week—Mr. WILLIAM ASHMOLE (the Chairman) presiding.

The report submitted stated that the sales of gas for the half year ended June 30 showed a decrease of 1·22 per cent. on the quantity sold during the corresponding period of 1914. This result was brought about by the continued official restriction of lighting. To meet the greatly increased cost of coal and the extra charges which fall upon the Company in consequence of the war, the Directors increased the price of gas 3d. per 1000 cubic feet from the reading of the meters for the Midsummer quarter. After providing for the interest charges, the balance of the profit and loss account available for dividend was £26,194, out of which sum the Directors recommended a dividend for the half year at the rate of 7⅞ per cent. per annum on the "A" and "C" stocks, and 6¼ per cent. per annum on the "B" stock, subject to deduction of income-tax. These payments would amount to £7132, and leave a balance of £19,062 to be carried forward.

The CHAIRMAN, in moving the adoption of the report and accounts, said he was pleased to report that the general business of the Company had been maintained, notwithstanding the adverse conditions. Not only did they have to pay greatly enhanced prices for coal, but some which they had been receiving was not up to the Company's normal quality; and it had been very difficult to keep the working up to its

customary standard. Though there had been the decrease mentioned in the sale of gas—due to the restriction of shop lighting, as well as to the earlier closing of premises—this did not necessarily mean that the Company were not securing new business. They were progressing satisfactorily in many directions, the effect of which would be felt later on. The various extensions in connection with new plant and alterations at the works had been somewhat hampered during the past year, through the shortage of labour; and the fact that they had been dealing so largely with rail-borne coal, all of which had to be handled at the works, had prevented them from using some of their regular hands in connection with the new work. They had at present under erection an extension to the washing and scrubbing plant and a new condenser; and to follow on after these were completed, there was the erection of a tar-tank and sulphate of ammonia still. The Company were doing extremely well with the output of gas appliances, and no doubt would reap a benefit from these in the future. A considerable number of these appliances were fixed in houses where the consumer was already supplied with a meter; and the tendency, therefore, was to increase the output of gas per consumer. The following figures would give some idea of the appliances sent out during the half year; the figures representing the net increases to the numbers on the district. A total of 207 gas-fires had been fixed, 192 gas cookers, 140 meters, and 38 geysers.

The report was adopted, the dividend recommended was declared, and hearty votes of thanks were accorded to the Chairman and Directors, the Engineer and Manager (Mr. W. B. Farquhar), the Secretary (Mr. G. H. S. Iorns), and the staff and workmen, for their services during the half year.

HARROW AND STANMORE GAS COMPANY.

Large Increase in Make per Ton.

The Ordinary Half-Yearly Meeting of this Company was held on Monday of last week, at the Holborn Restaurant, High Holborn, W.C.—Mr. ARTHUR F. PHILLIPS, M.Inst.C.E., J.P., in the chair.

The ENGINEER and SECRETARY (Mr. J. L. Chapman) read the notice convening the meeting; and the report [*ante*, p. 468] and statement of accounts were taken as read.

The CHAIRMAN, after expressing regret at the absence in America of the Vice-Chairman, Dr. J. W. Lee Glaisher, and at the inability of one of the Auditors, Dr. C. E. Goddard [who is serving his country at the front], to sign the accounts, proceeded to remark that the results of the past half year were exceedingly satisfactory—especially when the strenuous times through which they had passed were remembered. There was the difficulty of obtaining supplies of coal, and the uncertainty of when it would arrive after leaving the colliery; and there was also inconvenience in carrying on the business, with many of the Company's employees having enlisted in the Army. The total sales of gas were 163,319,000 cubic feet, an increase of 4,013,000 feet, or 2½ per cent., on the corresponding half year of 1914. This increase in the gas sold was highly satisfactory, considering there was a reduction of 3,850,000 cubic feet in the gas supplied to the public lamps, and all outside shop lighting had been discontinued. During the half year the Company gained 90 new ordinary consumers and 105 prepayment consumers, and fixed 200 new cooking stoves. It was from these that the additional consumption was obtained. It was gratifying to report that, while this additional quantity of gas had been sold, there was a reduction of 704 tons in the coal carbonized; and 13,441 gallons of oil less had been used for the production of carburetted water gas. The gas made per ton of coal was 13,402 cubic feet, against 12,257 feet the previous year—an increase of 1145 cubic feet, due to improvements in the retorts and carbonizing machinery. The gas made was under 1 per cent. more, whereas the increase in the gas sold was 2½ per cent., showing a reduction in the unaccounted-for gas of 1½ per cent. The Engineer was of opinion that this might be due to the reduction in the number of public lamps lighted. In this, he was probably correct; for the consumption of gas in the public lamps often exceeded the contract quantity. In the capital account, there was charged as expenditure during the half year for mains, meters, and stoves £1432; but, on the other hand, there was written-off for depreciation and charged in the revenue account £3266. Thus the capital showed a reduction of £1833, which was a pleasing feature with an increased consumption and works maintained in a thoroughly efficient state. The prosperity of a gas company was enhanced by the capital expenditure being low in proportion to the gas sold. This was keenly felt in these times of trial, and would probably have a greater effect in the future. It had been his aim to get down the capital in gas undertakings with which he was connected. It was the means to cheap gas. There was a time when the capital in this Company was excessive; but for some years the Directors had been endeavouring to reduce it, and fortunately with an increasing consumption, improved plant for more economically producing gas, and taking care that revenue bore all proper charges, the position had vastly improved. It was still higher than it should be; but the Board hoped to gradually further reduce it. Turning to the revenue account, coal had cost £8435, against £9523 in the previous year. This reduction was due to the coal having been obtained under favourable contracts made during the spring of 1914, and also to the reduced quantity carbonized. Oil cost £1105, against £1241, less being used; but coke for the production of carburetted water gas cost £232 more, by reason of its higher price. Repairs and maintenance of mains and services figured at £3430, against £1575. Rates and taxes [which were ever on the increase] were £244 more. The other charges were much the same as in the previous year, with the addition of a new expense of £247 war allowances to the dependants of those who were serving their country, which he was sure would meet with the hearty approval of the proprietors. The charges for repairs and depreciation of works, mains, services, meters, and stoves amounted to £9782, and was equal to over 1s. 2d. per 1000 cubic feet of gas sold, which indicated that the Board were aiming at reducing the capital charges. On the credit side of the account, receipts for gas were £29,555, against £28,235. Receipts for coke were £4016, compared with £3815. The increase was not greater because there was less for sale by reason of less coal being carbonized. The price obtained for tar was less by £275. The result of the half-year's work was a profit of £7967, against £7884 the previous year. Interest on debentures and loans absorbed £1095; their subscription to the National Relief Fund, £110; and the dividend proposed, £6772—making a total of £7978. With increased prices for coal equal to 25 per cent. on the contracts for the ensuing twelve months, it was imperative to raise the price of gas; and notice was given of an additional 2d. per 1000 cubic feet from Lady-day last. This increase was small compared with that of several other companies; and every endeavour would be put forth to make it suffice. No one with reasonable caution would forecast the future; it was beset with the gravest uncertainties. There might be trouble in obtaining coal; there might be great inconvenience in securing the labour required. Good stocks of coal were being procured; and the Board would endeavour to meet all difficulties as they arose. He concluded by moving that the report and statement of accounts be adopted.

Mr. SAMUEL CUTLER seconded the resolution, which was at once unanimously carried.

On the proposition of the CHAIRMAN, seconded by Mr. A. M. PADDON, a dividend was declared for the half year ended June 30 at the rate per annum of 5½ per cent. on the 5 per cent. ordinary stock, and 5 per cent. on the preference stock—both less income-tax.

The CHAIRMAN, proposing a hearty vote of thanks to the officers, said he was sure this acknowledgment was specially due to them for their services during the past half year. It had been a time of considerable anxiety in obtaining coal and other materials necessary for the manufacture of gas, and also in carrying on the work with the number of the Company's employees who had joined the army. He knew that Mr. Chapman had had an anxious time; and it was pleasing to see that, amid it all, he had devoted his attention to the improvement of the carbonizing plant, so as to obtain more gas per ton of coal, as the best means of meeting its increased cost.

Mr. A. W. OKE seconded the proposition, which was cordially agreed to.

Mr. CHAPMAN, responding, remarked that, although it had required great energy and great earnestness on the part of those who were at home, they had been able to get along well, and, in fact, to progress, amid things which seemed so untoward.

Mr. E. L. BURTON proposed a vote of thanks to the Chairman and Directors; pointing out that to be able to present so excellent a statement of accounts reflected the very highest credit upon all concerned. He was particularly pleased, as a proprietor, to see the very considerable amount the Board were devoting to the writing-off of wasting assets. This was an aspect of gas companies' business which was in certain instances very much neglected; and when one saw the Harrow Board devoting so much attention to the matter, it gave great confidence. Directors who were looking after the interests of shareholders as well as consumers, were doing the utmost they could for all concerned.

Mr. F. J. BANCROFT seconded the motion; and it was heartily carried.

The CHAIRMAN, in his reply, said the Board would certainly follow out the policy which Mr. Burton had approved, of writing-down the assets. This was the easiest method of getting the capital down.

PUBLIC LIGHTING OF MANCHESTER.

Demand for Less Stringent Conditions.

At a Board of Trade inquiry held at the Manchester Town Hall last week, regarding a serious tramway accident in South Manchester which occurred the previous week-end, Mr. Percy M. Heath (the Deputy Town Clerk) stated that the Tramways Committee were working under difficulties at the present time, owing to the fact that 2000 employees had joined the Colours, and that the part of the road where the accident occurred was not illuminated as the Committee would desire. Manchester, like London, was in a state of darkness in the evening. Describing the lighting arrangements at Alexander Road South and Wilbraham Road (near the scene of the accident), the Deputy Town Clerk said the driver took another light (some 200 yards distant from the proper light) to be the one near the curve where the car left the metals and toppled over. In all the circumstances, and seeing that the character of the illumination of the streets was not now controlled by the Corporation, there was some excuse for the driver's mistaken judgment. The driver was a man of good character, good health, and good eyesight.

The driver, in evidence, stated that he had negotiated this particular curve before, but at the time of the accident it was approaching dusk. In the darkness he was not at all confident as to where the compulsory stop was, and at night he identified it by the last request stop. On the night of the accident he had not been called upon to stop, and this had misled him. Mr. J. M. M'Elroy, the General Manager of the Tramways Department, said a certain lamp that had not been lighted prior to the accident had since been lit. Drivers were allowed 16 miles an hour on this particular part of the route. In his opinion, the accident would never have occurred if the lamp on the east side had been lit instead of another one. It was a case of lighting the wrong lamp. Mr. Heath remarked that representations had been made to the Home Office by the Gas Committee for some removal of the city's present lighting restrictions.

POSITION OF THE GAS DEPARTMENT.

A number of complaints have lately reached the Manchester Gas Department relative to the dark streets of the city and suburbs; but at the moment of writing no sanction has reached the authorities for the better illumination of the thoroughfares, or for the removal or modification of any of the already stringent lighting restrictions. With the advent of winter it is, of course, probable that complaints will increase. It is, however, anticipated that ere long the local Watch Committee (acting for the War Office authorities) will relax the rules somewhat, and that an additional number of lamps will be lighted on important tramway routes and at dangerous corners.

THE NORTH BRITISH ASSOCIATION DINNER.

In connection with the conclusion of our report (in another column) of the proceedings at the annual meeting of the North British Association at Edinburgh last Friday week, a correspondent who was present at the dinner to which the members and their lady friends were invited by the Cowdenbeath Gas Company sends a few notes which will be of interest.

He writes: A representative company, which included a number of ladies, assembled in the evening of the day of meeting in the North British Station Hotel, Edinburgh, as the guests at dinner of the Chairman and Directors of the Cowdenbeath Gas Company. Mr. James Hutton, the Chairman of the Board, presided over the function, which was altogether successful—amply fulfilling, in every way, the expectations of both hosts and guests. In the after-dinner oratory, more than ordinary prominence was given to loyal and patriotic sentiments. In this connection, much enthusiasm was evinced in the spirited speech from Mr. J. H. Bennet, one of the Directors of Cowdenbeath Gas Company, in proposing "His Majesty's Forces;" while the neatly-expressed acknowledgment by Lieutenant-Colonel Henry O'Connor, of the Inner Forth Defences, was greatly appreciated. Mr. W. L. Sleigh, in proposing the toast of "The North British Association of Gas Managers," made allusion to the successful manner in which gas engineers throughout Scotland were meeting the inroads of a formidable rival—electricity. From their achievements in the past, the gas engineers in Scotland and throughout Great Britain had, he said, demonstrated the possibilities and potentialities of the product in which they were interested. He was an optimist in these days; and he thought the development of the gas industry was bound to continue. In acknowledging the toast, the President of the Association (Mr. J. B. Scott) touched on a few points of interest to the members. The Association, he said, was growing in influence and importance; and in the near future they might have to consider the possibility of a two days' meeting, so as to overtake, discuss, and keep abreast of their business. Gas managers were at all times ready to render mutual aid to one another in situations of difficulty and perplexity; but the primary object of their annual meetings was so to disseminate knowledge that it would be for the direct benefit of the gas consumers. Touching upon the important place which Scotland took in the gas engineering profession, Mr. Scott mentioned incidentally that William Murdoch, of gas lighting fame, was also the inventor of the first motor-car which was propelled by steam. In the course of his speech, the President eloquently appealed for funds for the motor ambulance waggon which it is proposed that the Association should be responsible for, and present to the Scottish Section of the British Red Cross Society. Mr. Alex Masterton, of Edinburgh, who gave the toast of "The Cowdenbeath Gas Company," made complimentary reference to the progress of the gas undertaking in this important district of Fifeshire, and attributed the success achieved to the combined efforts and skill of the Directors and their Manager. The Chairman briefly replied.

FACTORY AND WORKSHOP LIGHTING.

Appendices to the First Report of the Committee.

The conclusions and recommendations contained in the first report of the Home Office Departmental Committee on Lighting in Factories and Workshops were published in last week's "JOURNAL" [p. 524]; and an indication may now be given of the contents of some of the series of seventeen appendices by which the report is accompanied.

At the beginning of the inquiry, a circular-letter was sent out by the Committee to 77 trade associations connected with the limited number of industries to which the Committee were for the time being confining their investigations; and from them 31 replies were received. This letter asked for any assistance it might be possible to give to the work of the Committee; and as an indication of the kind of evidence required, the following points were enumerated: (1) The possibility of defining and establishing a standard or standards of adequate illumination suitable for the various operations and processes in the trade represented by particular associations. (2) The classification of processes in relation to the illumination required. (3) The enumeration of the various processes in which specially good illumination is desirable, and information as to means of securing it. (4) Examples of processes presenting special difficulties in respect of efficient lighting, owing to the relative positions of the work and of the light-sources, or for other reasons. (5) Particulars of the methods of illumination in general use, with details of special systems which have been adopted for special processes. (6) The relative merits of daylight and artificial illumination, and the extent to which the latter is used, depending on the usual period of employment in the industry represented by the particular association.

Inspectors of Factories were also requested to forward notes regarding any point that might be of interest to the Committee. For instance: (1) Processes requiring exceptionally good light, by reason of the fineness of work, colour of material, or other circumstance; and the arrangements made to meet this. (2) Processes in which there is exceptional exposure to glare, and for what reason. (3) Processes in which the lighting is generally inadequate. (4) Examples of special means of lighting, or of protection from glare, and their efficiency. In response, reports were received from 30 districts, out of a total of 51. The summarized replies show a long list of processes requiring exceptionally good light by reason of the fineness of the work; several on account of the colour of the material; laundries, bakeries, wool-sorting and manipulation of dangerous wools and hides, to ensure cleanliness and good sanitary conditions; and dry-cleaning, metal-box making, and iron-foundries, for the avoidance of accidents. Among the processes in which there is exceptional exposure to glare, from one cause or another, are mentioned the retort-houses of gas-works, burning-off in mantle factories, electric glow-lamp works, carbide of calcium factories, oxy-acetylene welding and cutting, electrical welding, and the generation of electricity.

LIGHTING REQUIREMENTS IN FORCE.

In a section dealing with the requirements as to lighting of factories, schools, and other buildings in force in the United Kingdom, it is stated, referring first to factories, that no general provisions in respect of lighting of factories and workshops [analogous to those in the matter of temperature and ventilation] occur in the Factory Acts. The only reference to the subject is found in the Factory Act of 1901, section 101 (4), which specifies adequate lighting among the conditions on which the local authority must be satisfied before an underground bakehouse is certified as suitable for use. Under section 79 of the Act of 1901, the Secretary of State has power to make regulations for certain trades which have been certified by him to be dangerous. These regulations, after conforming to a certain procedure, eventually attain the force of statutory enactments. Some twenty codes of regulations exist, five of which contain references to lighting. They deal respectively with docks, the use of locomotives, &c., on premises under the Factory Act, vitreous enamelling of metal and glass, generation, &c., of electrical energy, and manufacture and decoration of pottery.

In connection with primary and secondary schools, the regulations in force state that the colouring of the walls and ceilings and of all fittings should be carefully considered as affecting the light. This point, and the size and position of the windows, are specially important in their bearing on the eyesight of the children.

It is pointed out that the following reference to lighting occurs in the report of the Departmental Committee appointed to inquire into the machinery and engineering staffs at Poor-Law Institutions: The number of institutions where gas is produced on the premises is small. Those where electricity is generated are more numerous; but as a rule light is obtained from a public supply. Electric lighting is generally considered to have advantages over gas lighting for institutions; but a saving in cost for illuminating purposes alone is not usually counted among these advantages. Evidence was, however, submitted to the Committee of economies effected in the cost of lighting by substituting electricity for gas. It was not contended that, light for light, electricity was cheaper. The saving was attributed to the readier facilities for controlling the use of electricity. It appears to the Committee, however, that much more care can be exercised in controlling the consumption of gas than is at present often the case, and that sufficient advantage has not been taken of the opportunities of economizing by the use of incandescent mantles. On the whole, it does not seem to them that there is adequate evidence to justify the substitution of electricity for gas at institutions where gas is already in use. At new institutions, the question is more open, and depends largely upon local conditions.

A section follows on the requirements as to lighting of factories and schools in force in certain foreign countries. Generally, it is laid down that the lighting shall be "efficient" or "adequate." In Holland, however, there are some definite figures quoted. A young person or a woman may not be employed in a factory or workshop engaged on certain specified industries unless the illumination on the place of work amounts to at least 30 Hefner units at a distance of 1 metre [equivalent to about 3 foot-candles], or any other kind of work which requires good light, unless the illumination on the place of work amounts to at least 20 Hefner units at a distance of 1 metre [equivalent to about 2 foot-candles]. In addition to the general requirements quoted, special provision as regards lighting has been made for particular industries. Added to the general requirement of adequate lighting, there is in Maryland the following provision: "Any room or apartment . . . wherein, if of less superficial area than 500 square feet, any artificial light shall be habitually used between the hours of 8 a.m. and 4 p.m. . . . shall be deemed to be a place involving danger to the public health."

In regard to the lighting of national schools in Lower Austria, it is stated that, for the general artificial illumination of class-rooms the use of diffused lighting reflected from the ceiling is recommended as the best. All hanging lamps must be fitted with appliances screening the lights from the eyes. The sources of light must be fixed at least 0·5 metre (20 inches) away from the heads of the pupils when reading or writing. The illumination must be sufficient to enable "diamond" type to be easily read by a normal eye at a distance of 0·5 metre, corresponding to a minimum illumination of 10 normal metre-candles [about 1 foot-candle]. It is recommended in Belgium, in connection with primary schools, that, where artificial light is used, care must be taken that "noxious products of combustion" are removed by placing above the light-sources pipes connected with the central flue, and arranged so as to expedite the ventilation. A distance of about 1·4 metres (4½ feet) should be maintained between the desks and the reflectors, to protect the heads of the scholars from excessive heat.

There are no special regulations for the artificial lighting of class-rooms in Denmark; but there have always been definite rules which are observed for the arrangements in this connection. In 1898 and the two following years, incandescent gas-lamps were introduced into all schools, both old and new. Four of these, of 75-candle power each, were provided for a class-room of 47 square metres floor space [487 square feet], corresponding to a proportion of 6·3-candle power per square metre [0·62-candle power per square foot]. The lamps were all furnished with shallow conical reflectors and eye-shades. This system is still in use in all schools built before 1908; but since that date, electric light has been installed in all new schools. In France, illumination derived from diffused electric light reflected from the ceiling, is recommended. It is found that a light-source of about 25-candle power at a distance of 1 metre is sufficient for reading and writing in class-rooms in Sweden. All lamps must be so placed that the pupils are not compelled to look either straight at them or directly past them. If arc lamps are used, indirect lighting should be adopted. It is found for artificial lighting in rooms used for industrial instruction that incandescent gas possesses the disadvantage that the lighting power of the mantle falls off very quickly, owing to the fine sawdust present in the air settling partly on the mantle and partly in the orifices of the burner.

(*To be continued*)

GAS WORKERS AND WAR BADGES.

Some remarks in the current number of the "Birmingham Gas Department Magazine," on the subject of gas workers and war badges, supplement a statement made in the same publication a month ago [*ante*, p. 357], as to the issue of war badges to Gas Department employees; it being then mentioned that the badges were to be provided by the department, and not by the Government. The following information is now given by the "Magazine."

A few days after the issue of the "Magazine," we understand the department received an intimation from the Ministry of Munitions that official badges would be provided for certain classes of workmen employed by the Department; and these are now being issued. Authority has been received for badges to be given only to skilled and semi-skilled indispensable workmen employed in the supply of gas for power and heat for munitions factories, and in the extraction of toluol for high explosives. The Government regulations distinctly prohibit the issue of badges to men usually classed as "unskilled," or to men engaged on purely private or non-war work. This is regrettable, as, apart from the invidious distinction which has consequently to be drawn between men engaged on the same works, the "unskilled" gas-works labour is, under the present abnormal circumstances, as difficult to obtain as the skilled and semi-skilled, and is equally as essential for the carrying on of the works.

DEWSBURY MUNICIPAL UNDERTAKINGS.

The abstract of accounts of the Dewsbury Corporation, for the year ended March 31 last, compiled by the Borough Accountant (Mr. John Hutchinson), gives, of course, particulars relating to the gas and other reproductive undertakings.

It seems that on the gas-works there was a gross profit of £13,717, out of which over £9000 was paid in respect of sinking fund and interest. The net surplus was £4413 for the year, and £7993 had been brought forward, making a total of £12,406, from which £9700 was transferred in aid of the borough rate and £100 was granted to the Public Library Committee. There then remained a credit balance of £2606, a decrease of £5387. The balance-sheet of the undertaking gives the surplus of assets over liabilities as £114,786. Last year sales of gas produced £32,154 (an increase of £1000 on the preceding twelve months); but residual products went down by £1600—from £12,654 to £10,938. Consumers of gas through ordinary meters paid the Corporation £23,884; and £8463 was received for gas supplied through slot meters.

The gross profits on the electricity works were £6364. After adding £984 brought forward and some smaller items, there was available £7355, out of which £4500 went to sinking fund and interest, £1000 to reserve fund, and £500 to the renewals fund. The net result of the twelve months' working was that the reserve and renewals funds were strengthened to the extent of £1500, and that the credit balance on revenue account was increased by £363, from £984 to £1347. On capital account, the estimated surplus of assets over liabilities is now £40,317.

After paying for water received, and the expenses on distribution, the water department yielded a gross surplus of £16,034, to which there was added £2072 brought forward from the previous year, making a total of £18,106. The receipts included £4800, the borough's three-fourths share of the profits of the Dewsbury and Heckmondwike Water Board. Nearly £13,500 had to be paid into the sinking fund and for interest, and £1449 was given in relief of rates. But after all this had been done, the credit balance was increased by £1140, to £3212. The sales of water for domestic purposes produced £11,361, and for trade purposes £13,126. The capital account gives the assets as £185,564 in excess of liabilities.

DISPUTE AS TO A WATER SUPPLY IN BULK.

Second Day's Proceedings of the Morpeth and Tynemouth Arbitration.

A report has already been given in the "JOURNAL" [*ante*, p. 532] of a portion of the proceedings in an arbitration which took place some time ago with reference to a dispute between the Morpeth Corporation and the Tynemouth Corporation as to the correct interpretation to be placed upon an agreement for a supply of water in bulk. Morpeth contended that they were entitled to a direct connection between their supply main and the gravitation main of the Tynemouth Corporation; and on the award being stated in the form of a special case, the Court upheld this view.

Mr. A. J. RAM, K.C., acted as Arbitrator. The Counsel engaged were Mr. HOLMAN GREGORY, K.C., and Mr. SCHOLEFIELD, for the Morpeth Corporation; and the Hon. J. D. FITZGERALD, K.C., and Mr. C. F. LOWENTHAL, for the Tynemouth Corporation.

Mr. FITZGERALD proceeded to read some correspondence when the proceedings were resumed on the second day; and at the conclusion of this,

The ARBITRATOR said: I presume it cannot be denied that if the water is given under pressure, Morpeth would get, and Tynemouth would give, a very much larger quantity per annum than if it were given not under pressure. If it is given under pressure, it will serve a very much larger area than if it is not.

Mr. FITZGERALD: It is not a question of serving the whole town. All they want is a supplementary supply. I do not think, so far as I

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can form an opinion, that it makes any difference in the quantity. They can take without pressure just as much water as they could take under pressure.

The ARBITRATOR: They could; but they might not have the same inducement to take it.

Mr. HOLMAN GREGORY: Not only that, but we could not use it; and therefore we could not take it.

The ARBITRATOR: Presumably if Tynemouth have spare water, it is to their advantage to sell it. If they have not, they are relieved from the agreement to supply water at all through this main.

Mr. FITZGERALD, addressing the Arbitrator for Tynemouth, said the question here was really one of law. The point was what the agreement meant; and most of the evidence given was entirely outside this. He understood Morpeth to set up a double contention. They said, firstly, that they were entitled to have the water delivered under pressure from the gravitation main into their service main; and, secondly, that they were not required to specify any quantity of water or any time during which they would take it. The only limit was the 20 gallons per day per head of the population. The first observation that he had to make was that this supply was a supply in bulk, and nothing else. It was given under section 37 of the Tynemouth Corporation Act of 1898, in which nothing at all was said about pressure. There being no obligation in the section to deliver a supply at any pressure, if such an obligation was to be placed upon the Corporation it must be by express agreement. There was, however, not a word in the agreement about supply by pressure. If such a supply had been intended, nothing would have been more simple than to have so stated it in the agreement. His second observation was that, according to the decision given by Mr. Justice Swinfen-Eady in the Dearne Valley case, a supply in bulk did not mean a supply under pressure; but it did mean a supply given by an equable flow throughout the whole of the 24 hours. These points were expressly decided in the Dearne Valley case; and he was rather surprised that his learned friend, in opening, made no allusion to this decision. As had been remarked already, the Tynemouth Corporation were in possession of a supply of water larger than they required. Indeed, they had surplus water at the present time running to waste. It was therefore to their interest to sell it; and there was no ground whatever for the insinuation that this was an attempt on the part of Tynemouth to get out of the agreement because they did not want to give a supply. What they declined to do was to furnish a supply according to a method which, in their view and in that of their advisers, they were not bound as a matter of law to give, and which was from a water-works point of view objectionable. Which witnesses were right and which were wrong was, however, entirely beside the question; for even if Tynemouth were quite unreasonable about the matter, it would be immaterial to the construction of the agreement. The agreement was in perfectly plain and simple English, and entitled Morpeth to a supply of water to be taken from the gravitation main at some place on Morpeth Common—the Tynemouth Corporation to make the connection, at the cost of Morpeth. Tynemouth had always been willing to give a supply from this main; and he wished to relieve them of any imputation of having acted unreasonably or from any indirect motive in the matter. He then proceeded to deal with the agreements made with other authorities for bulk supplies off the main.

Mr. HOLMAN GREGORY pointed out, however, that in those cases the price was 4d. per 1000 gallons; whereas Morpeth paid 6d., because they had the option of taking the water when they liked.

Mr. FITZGERALD (continuing) argued that, in addition to the point about pressure, the Arbitrator should rule that Morpeth were bound to state what quantity of water they required and for what period.

Mr. HOLMAN GREGORY: If my clients consent to this being dealt with now, it ought not in any way to bear upon your decision as to who should pay the cost of these proceedings. It is a new point altogether. I agree you should give a decision as to what should properly be the contents of the notice required by the terms of the agreement.

Mr. FITZGERALD said it would be unreasonable that Tynemouth should simply be given a notice to require water without specifying the quantity and period of the bulk supply. In the case of the *Wombwell Urban District Council v. Dearne Valley Water Company*,* the Council were entitled to get a supply in bulk from the Company; and they raised the two questions just discussed. The substantial provision of the agreement was: "The meter shall be placed, and the water delivered and taken, at a point along the Company's mains to be mutually agreed upon between the Company and the Council." The Court held that the Company were not bound to deliver the water at greater pressure than would make it reach the point of delivery; and that the Council were bound to take it regularly, and store in their reservoirs any surplus against future needs. The circumstances of the cases seemed to be practically the same; and the decision given was of general effect with regard to a supply in bulk. In conclusion, he pointed out that he had stated at an early period of the hearing that he would ask the Arbitrator to state his award in the form of a special case, as there was a substantial question of law involved.

Mr. HOLMAN GREGORY, in reply, said it was perfectly clear that the facts of the Dearne Valley case differed entirely from those of the present one. The outstanding feature which distinguished the Dearne Valley case from the matter now before them was that when the agreement was entered into there was no question of water being delivered under pressure, because the Special Act exempted the Company from supplying under pressure. There was a special provision that the water supplied under it need not be constantly laid on under pressure; and at the time the contract was made between the parties, nothing was said as to how the water was to be delivered. Later there was a Provisional Order which stipulated that the supply for domestic purposes

* An extended report of the case to which Counsel referred—that of the *Wombwell Urban District Council v. Dearne Valley Water Company*—will be found in Vol. XCVIII. of the "JOURNAL," pp. 595, 751, and 825.

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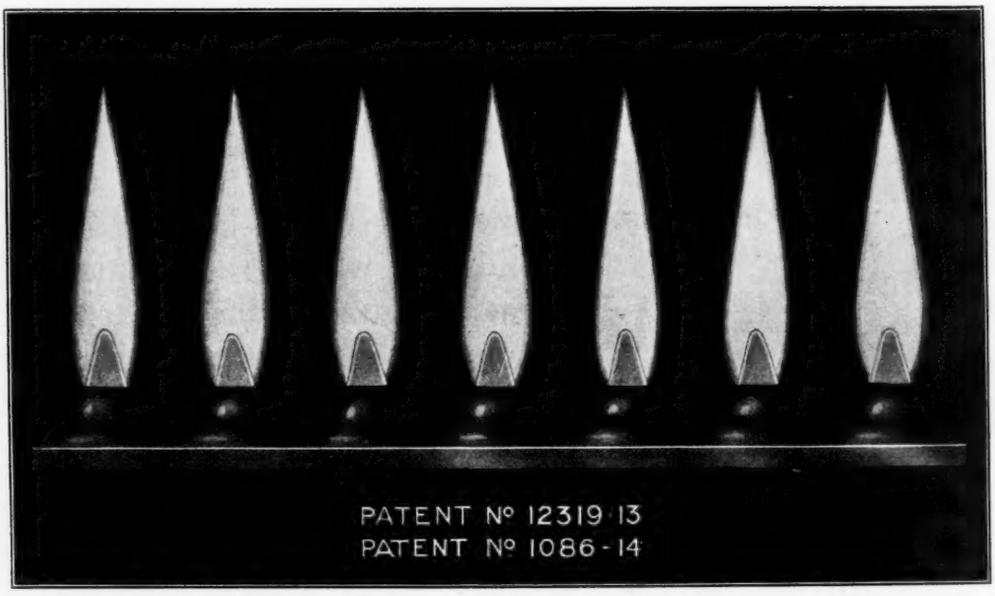

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to the Company's own district was to be under pressure; and as the water was going through the main under pressure, the Wombwell Council said they were entitled to have it under pressure. The Judge, however, said the Order did not interfere with the agreement which the parties arrived at between themselves before the Order was made, because the Order only said that the water had to be delivered under pressure for domestic purposes in the Company's own district. As to the main contention before the Arbitrator, the Morpeth Corporation were contending that they were entitled to a connection which would give them the benefit of the water in the gravitation main as it then existed. He was not maintaining that Tynemouth were bound to deliver at any particular pressure, but that Morpeth were entitled to the water at a definite spot, with all its virtues and all its detriments. It must not be taken that he was assenting to the Arbitrator stating his award in the form of a special case. He desired to leave open any points that he might be in a position to take upon the matter.

This concluded the hearing before the Arbitrator.

Subsequently, the special case stated by Mr. Ram came before Mr. Justice ATKIN, sitting in the King's Bench Division of the High Court of Justice. Mr. HOLMAN GREGORY, K.C., and Mr. J. SCHOLEFIELD again represented Morpeth; while Mr. SCOTT FOX, K.C., and Mr. C. F. LOWENTHAL appeared for Tynemouth.

The case which was argued, after reciting the facts, as agreed by Counsel, set forth the alternative forms of the award, and declared that the costs of the reference and the award should follow the decision of the Court.

Mr. HOLMAN GREGORY emphasized the importance to Morpeth of receiving the water under the pressure at which it would naturally leave the gravitation main.

Mr. SCOTT FOX, in replying, maintained that the gist of the matter in dispute was whether the Morpeth Corporation were to take the water, or the Tynemouth Corporation were to deliver it.

His LORDSHIP, in giving his decision, said he thought the Morpeth Corporation were entitled to a direct connection between their supply main and the gravitation main of the Tynemouth Corporation, at a place agreed upon.

Lincoln Gas-Workers' Wages.—There has been a good deal of agitation at Lincoln as to wages; it being reported at a meeting of the Council last Tuesday that an application had been made to the Gas Committee on behalf of the unskilled hands employed at the Bracebridge works, with the result that wages had been increased to 6d. per hour for a week of 54 hours. The arrangement is that they shall be paid only for the time actually worked, and that the payment of wages during holidays should be discontinued.

NOTES FROM SCOTLAND.

From Our Own Correspondents.

Saturday.

The price of gas to ordinary consumers in Aberdeen has been fixed at 2s. 6d. per 1000 cubic feet—3d. less than last year. The charge for gas-engines is to be 2s. 2d. per 1000 cubic feet—an increase of 3d. The Electricity Committee recommended that the charge for electricity be fixed at the same rate as last year, with the addition of 15 per cent.; but the Council resolved to remit the matter back to the Committee for further consideration.

At a meeting of the Greenock Gas Committee last week, the financial statement for the past year was submitted and estimates for the current year were disposed of. The surplus on the year's working was £1582. The estimated deficiency for the coming year, £7000, was to be accounted for mainly by the increased price of coal. In order to meet this, it was decided to recommend that the ordinary lighting rate be increased from 2s. 6d. to 2s. 11d. per 1000 cubic feet, and the slot meter rate to 2s. 10d.; the power rate remaining at 2s. 3d. This is expected to result in a net balance of £130.

The offer of the Peterhead Town Council to settle a gas-workers' wages dispute by arbitration has been agreed to by the Union officials, provided no undue delay is experienced in the settlement, and that retrospective consideration be given to the claims of the men. Attention having been called to the need for economizing, and in view of the large decrease in the manufacture of gas and the falling off in the sale of residuals, it was unanimously agreed that the Manager should combine with his own duties that of the foreman also, and that the latter's services be meantime dispensed with.

An explosion occurred a few evenings ago in Glasgow, as the result of an accumulation of gas in five manholes. An escape of gas had been detected in the manholes, which are situated in High Street; and before the explosion a gang of workmen had been engaged in locating the source. For a time the tramway service was suspended. As the streets were crowded at the time, the affair created some alarm; but fortunately no one was injured.

The Glasgow Corporation have had a report by the Parliamentary Bills Committee to the effect that in connection with the proposed Corporation Water Order, which provides for the inclusion of the River Turk in the Loch Katrine water area, arrangements have been made whereby the Earl of Moray is to receive £30,250, and the Crown authorities £2250, in full discharge of their claims at the Royal Forest of Glen Finlas. A report on the scheme states that a supply of at least 15 million gallons daily, over and above compensation water, will be obtained, and for this quantity the estimated cost of the works is moderate. In the compensation to be paid—viz., £32,500—is embraced the ground for the dam, reservoir, buildings, wayleaves, &c. The claims of the agricultural tenants have still to be met.

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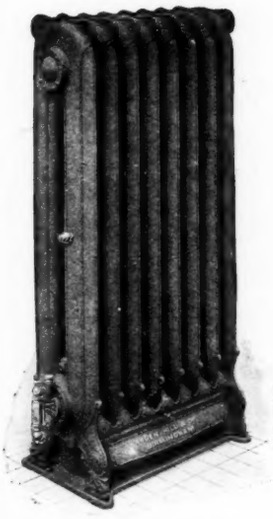

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CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

LONDON, *Sept.* 13.

There is rather more inquiry for pitch, but otherwise there is nothing particular to record in the tar products market. Values generally remain without change at the figures last reported.

The quotation for sulphate of ammonia remains unaltered at £14 8s. 9d. per ton net, into buyers' bags, at makers' works, for 25 per cent. quality.

Tar Products in the Provinces.

Sept. 13.

There is little alteration in the market for tar products. Pitch is still very difficult to sell, and at the present moment buyers abroad will not pay the prices being asked on this side. Solvent and heavy naphthas are in very good demand. Creosote is quiet; and there are some quantities offering at fair prices without finding buyers.

The average values of gas-works products during the past week were: Gas-works coal tar, 21s. 3d. to 25s. 3d. Pitch, East Coast, 21s. 6d. to 22s. per ton; Norfolk, Suffolk, and Humber ports, 19s. to 20s.; West Coast, 20s. to 21s. Manchester; 21s. to 21s. 6d. Liverpool; 23s. Clyde. Benzol, 90 per cent., North, 10½d. to 11d.; 50-90 per cent., naked, North, 1s. 3d. to 1s. 4d. Toluol, naked, North, 2s. 2d. to 2s. 4d. Crude naphtha, in bulk, North, 6d. to 6¼d. Solvent naphtha, naked, North, 1s. 10d. to 1s. 11d. Heavy naphtha, naked, North, 1s. 2d. to 1s. 3d. Creosote, in bulk, North, 2 15/16d. to 3d. Heavy oils, in bulk, 3⅞d. to 4d. Carbolic acid, casks included, 60 per cent., East and West Coasts, 3s. 5d. to 3s. 6d. Naphthalene, £8 to £16; salts, 75s. to 80s., bags included. Anthracene, "A" quality, 2d. to 2½d. per unit; "B" quality, nominally ¾d.

Sulphate of Ammonia in the Provinces.

LIVERPOOL, *Sept.* 11.

In the early part of the week the market remained very firm, but towards the close the tone has become quieter, and values have receded slightly. The volume of business has not been large, as, on the one hand, purchasers have been rather indifferent, and, on the other hand, makers have not given way willingly. To-day's quotations are £14 1cs. per ton f.o.b. Hull, £14 12s. 6d. f o.b. Liverpool, and £14 15s. f.o.b. Leith. Producers have maintained a firm attitude for future delivery, and continued to demand a premium of 5s. to 10s. per ton on prompt prices for October-March, but no first-hand transactions have been reported.

Nitrate of Soda.

This market has remained very firm, and the quotations on spot are now 13s. 9d. per cwt. for ordinary, and 14s. 3d. for refined quality.

Sulphate of Ammonia.

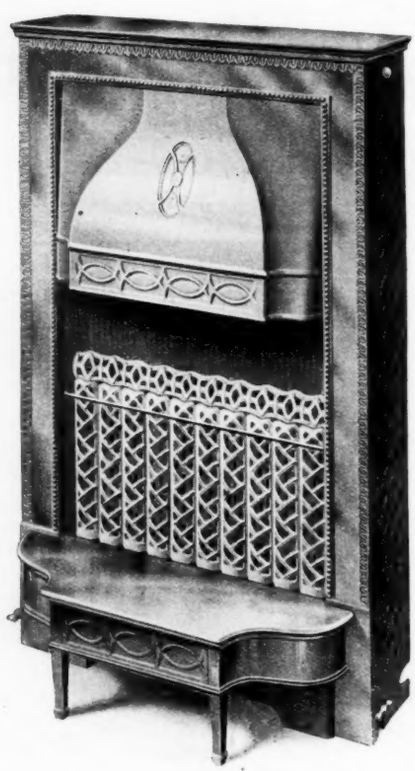
From another source it is stated that the market seems to have steadied itself throughout the past week, and prices have improved slightly. Outside London, makes are quoted at £14; Hull, £14 7s. 6d. to £14 10s.; Liverpool, £14 10s. to £14 12s. 6d.; Leith, £14 12s. 6d. to £14 15s.; Middlesbrough, £14 10s.

COAL TRADE REPORT.

Northern Coal Trade.

The coal trade is still quiet, owing to the lack of ready steamers and the restriction of coal licences, except to France. That country has increased its demand for fuel, and there has been some easing of the conditions of licences to it. In the steam coal trade, the tone is quiet, and prices are again weak. Best Northumbrian steam coals are from 18s. to 18s. 6d. per ton f.o.b.; for second-class steams, the current quotation is about 16s. to 16s. 9d. per ton; and steam smalls are rather lower at 12s. 3d. to 14s. per ton. Production is full for all the needs; but for ready tonnage the demands seem to vary a good deal. In the gas coal trade, the requirements appear to be steadily increasing—the demand being good for the south of England and for France. Best Durham gas coals are quiet, at from 19s. to 19s. 6d. per ton f.o.b.; second-class qualities are little altered in value at 17s. to 17s. 6d. per ton; and "Wear Specials" are relatively steady at 21s. 6d. to 22s. per ton. Rates of freight on gas coals show more variation—from 7s. to 8s. 6d.; the former rate, however, being that of a "Government boat." There is little doing in contracts ahead at present, as some buyers seem to hope for lower prices before the winter demand reaches its fullest, though there is still some further reduction of the miners in the Durham county by enlistment. Coal shipments from the Tyne now begin to show some increase when contrasted with the diminished exports a year ago. Coke is on the whole steady, with normal shipments from the Tyne. Good gas coke is from 28s. 6d. to 29s. 6d. per ton f.o.b. in the Tyne.

War Bonus Question at Oldham.—The war bonus question at Oldham was considered *in camera* at a meeting of the Town Council last Wednesday. At the close of the meeting, the Mayor stated that letters had been received from Mr. J. R. Clynes, M.P. (the General Secretary of the Gas-Workers' Union), and from the District Secretary of the Municipal Employees' Association, in furtherance of the men's claims. The Council, he said, re-affirmed their decision to grant an advance of 2s. per week to all adult employees who were in receipt of 28s. per week or less, and 1s. to those receiving 29s.—confining the increase to those whose wages with the advance will not exceed 30s. per week. The letters received from the Unions both took the same line of argument, that while 2s. per week extra might prove acceptable to employees not receiving 30s., those getting more than 30s. should also have a war bonus.



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Gas Exhibition Salons, **60, Oxford St., London, W.**

Winchester Water and Gas Company.

Moving the adoption of the report [*ante*, p. 469] and accounts at the half-yearly meeting of the Company, the Chairman (Mr. J. C. Warner) remarked that the six months ended June had been one of the most anxious periods the management had experienced since the commencement of the undertaking. Apart from the general trouble caused by the war, they had had a large amount of extra work thrown upon them. The result of this extra work was shown in their report in two ways. They had had a large increase in revenue, both from the sales of gas and water, and an equal and corresponding increased expenditure in producing the gas and in pumping and distributing the water. It must be obvious to the shareholders that the profit they made from the sale of gas was mainly dependent on the price of coal. Unfortunately, as all of them knew, the price of coal had considerably increased the past few months. With regard to water, he would like to say that, owing to the establishment of the military camps in the neighbourhood of Winchester, and also to the fact that during a part of the period under review there was a large number of troops billeted in private houses in the city, the demand on their resources for the supply of water had been greater than ever before. He thought in this respect the citizens were much indebted to the management of the Company, because unless the Company had been able to supply the water the establishment of these camps could not have taken place in the locality. Another anxiety which had presented itself had been the damage their mains and services had sustained from the heavy traction traffic through the streets of Winchester. They had had to make provision for repairs in this respect, which would be carried out when labour was available. Shortage of labour, too, had rendered it impossible to carry out the ordinary every-day repairs, to keep the plant in full and efficient working condition. They had, therefore, out of the earnings of the half year, which were larger than usual, made provision to meet the expenditure later on. Great anxiety had been caused the Engineer (Mr. H. C. Head), and other officials of the Company, by the extra work and trouble imposed upon them; but both shareholders and consumers were indebted to Mr. Head and his staff for the way in which the business had been conducted. The report was adopted; and a dividend of 4 per cent. per annum on the preference stock and 4¼ per cent. on the consolidated ordinary stock was declared.

Gas for Power at Ballymena.—At a meeting of the Ballymena Urban Council, letters were read asking for re-consideration of a decision in regard to the cost of gas for power; the contention being that there should be a difference in the charge for this purpose and that for lighting. Local firms, on this understanding, had installed expensive machinery, and felt that they were hard hit by the recent change. The Chairman (Mr. S. Hood, J.P.) said it was thought that a uniform rate of 4s. 7d. per 1000 cubic feet would be equitable; but if a slight reduction could be made for power, there would be no objection. It was eventually arranged to leave the matter to a Committee.

Gas Worker Refused a "Leaving Certificate."

During proceedings at the Sheffield Munitions Court last week—at which Sir William Clegg sat as Adjudicator, Mr. J. B. Bardsley represented the Employers' Panel, and Mr. H. A. Stone the Men's Panel—some of the cases showed that the applicants for "leaving certificates" desired to change their employment solely to get higher wages elsewhere; and in each instance the Court refused to make an order for a certificate to be given. In one case, John A. Madeley, a fitter's labourer, who was in the employ of the Sheffield United Gas Company, gave a week's notice, and left his employment, with the object of entering the service of Messrs. Thomas Firth and Sons, at a wage, including war bonus, 5s. in advance of what he was receiving from the Gas Company. He gave a week's notice to his foreman, and nothing was said to him at the time. On behalf of the Gas Company, it was stated that they wanted men, and could not do without any of their present staff. The Company's concern was an essential factor in the work of munitions; for they supplied a great deal of the power to the munition works. Sir William Clegg, when announcing that a certificate could not be granted, said it would have probably saved a good deal of trouble if the foreman who received the notice from the applicant had told him that they could not possibly do without him.

A Dutch Mantle "Made in England."—At the Leeds Police Court last Tuesday, the Direct Supply Company, of Merrion Street, were fined £3 for having sold an incandescent gas mantle of Dutch manufacture, the cover of which bore the inscription "Made in England." The Magistrate took the view that a mistake had been made.

Public Lighting Economy at Stafford.—Considering the question of effecting economy in public administration, the Stafford Town Council, on the recommendation of a Joint Committee, decided that the extinguishing of all public gas-lamps should commence at eleven o'clock in the evening, and that eight of the all-night electric lamps should be discontinued. In consideration of this reduced lighting, the Gas and Electricity Committee agreed to a reduction in the charge for public lighting of £350 a year.

Tamworth Gas Company.—At the annual meeting of the Company, the Directors reported that the accounts for the year ended June 30 showed a surplus on the working of £2181. The coal contracts for the year on which they were now entering had had to be made at prices greatly exceeding those paid for the past twelve months. They considered it neceessary to purchase and store greatly increased stocks of coal. Owing to these and other circumstances, the Directors had been reluctantly compelled to temporarily increase the prices charged for gas 5d. per 1000 cubic feet, as from the meter-taking at June 30. A dividend for the half year to Dec. 31 at the rate of 10 per cent. per annum on the new shares, less income-tax, having been paid, the Directors recommended that a similar dividend be paid for the six months ended June 30.

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Price of Gas at Newtownards.—The Newtownards Urban Council have decided to increase the price of gas for all purposes 5d. per 1000 cubic feet from Oct. 1. The Chairman (Mr. T. R. Lavery, J.P.), at the Council meeting, said, even with this increase, Newtownards would have the cheapest gas of any inland town in Ireland.

New Gasholders at Kirkby.—At last Tuesday's meeting of the Kirkby-in-Ashfield Urban District Council, it was stated that a mortgage had been effected for raising £5500 to defray the cost of a new gasholder. The Works Manager (Mr. G. M. Gribble) reported upon the Government suggestions regarding the manufacture of toluol; but it was decided, upon the information before the Committee, that no action should be taken.

British Coalite Company.—The Secretary of the British Coalite Company, Limited, states that the option to purchase part of the freehold properties belonging to the Company has now been exercised by the holders; and, on completion of the necessary formalities, the outstanding first mortgage debentures of the Company will be paid off at the rate of £105 per cent. The £75,000 second debenture stock of the Company thus becomes a first charge on the Company's property.

Ballymena Gas Undertaking.—Messrs. Martin, Shaw, Leslie, and Shaw have reported on the audit of the Ballymena gas accounts. The total revenue for the year was £6247, and the expenditure £5298, leaving a trading profit of £949. Deducting from this interest on loans, left a surplus of £194. The gas used by private consumers for lighting and heating amounted to 20,142,800 cubic feet, which, after deduction of discount, realized £3948—an average of 3s. 10·04d. per 1000 cubic feet, compared with 3s. 11d. the previous year.

Australian Gas Light Company (Sydney).—During the half year ended June 30, net profits amounting to £52,609 were earned by the Company; and the sum available for allocation is £64,154, of which £52,275 is absorbed by dividends at the rates of 7 per cent. on the "A" and "B" shares, and 6 per cent. on the "C" shares, leaving £11,880 to be carried forward. In consequence of the price of gas having been increased in November last, the dividend has been reduced, in order to comply with the New South Wales Gas Act, 1912. It is the intention of the Directors to increase the capital by issuing 50,000 "C" shares.

Milnrow Gas Company.—At the half-yearly meeting of the Company, the report and balance sheet were adopted, and the usual dividends declared. The report showed that the profit earned during the first six months of the present year was the largest since 1903, excepting the corresponding half years of 1913 and 1914. The profit on revenue account reached £793. The dividends this half year are to be 9 per cent. on the old shares and 6 per cent. on the new ones. The balance available for dividend is £804, which compares with £867 twelve months ago. The dividends are now declared [as they also were six months ago] less income-tax, instead of free of tax. The reserve fund remains at £1300.

Dublin Lighting Control.—At last week's meeting of the Dublin Corporation, a report from the Lighting Committee recommending an amalgamation of the Committee with the Electricity Supply Committee was on the *agenda* for confirmation. The matter fell through; the necessary two-thirds of the Council not being present when the roll was called. Mr Cole (the Chairman of the Lighting Committee) said the recommendation was made on the ground of economy. The Citizens' Association were anxious for economy; but when this subject came up, members not only called out their friends, but themselves walked out of the Council Chamber. Alderman Quaid expressed the view that gas should not be exploited in the interest of the electricity enterprise.

Lewes Gas Company.—In the report which was adopted at the meeting of the Lewes Gas Company last week, it was stated that the revenue account for the six months ended June 30 showed a profit of £1507. The Directors recommended that dividends for the six months be declared at the rate of 5 per cent. upon the original capital stock and 3½ per cent. upon the additional capital stock—absorbing (after deduction of income-tax) £1329. The Chairman (Mr. M. S. Blaker, referring to coal, said the difficulties of supply had been greatly increased by the fact that the port of Newhaven, through which the bulk of their supplies used to come, was practically closed for ordinary traffic. They had been able to get through a few small cargoes, for which they were largely indebted to the ingenuity of their Manager (Mr. Edward Jones). The Directors had had under consideration for some little time the question of an increased production of gas, more especially during the winter months; and, advised by Mr. C. F. Botley, of Hastings, they had decided to instal a carburetted water-gas plant and a booster.

Government and the New Water-Main at Torquay.—The Local Government Board appear to be unable to decide whether the laying of the new water-main to supplement the supply of water to Torquay should be allowed to continue. Contracts have been entered into by the Torquay Corporation, and the work is in hand, and the Water Committee have furnished the Board with a statement of the reasons why, in their opinion, it should be continued and completed in spite of the general instruction against incurring capital expenditure on local undertakings. In reply to this, the Board wrote that they were of opinion that the work should be stopped as far as possible, and asked for a statement showing the total liabilities to be met on the ceasing of the work. It was reported at a meeting of the Town Council last Tuesday that the Water Engineer (Mr. S. C. Chapman) had prepared a statement showing the amount for which the Council were liable to the contractors for pipes and for work done and to be done, and also of the money paid and due. He also reported the terms on which the contractors were prepared to stop the work. The Water Committee were of opinion that the Local Government Board should be again approached on the matter; and a special report was prepared for submission to the Board. The Town Clerk and Water Engineer were instructed to interview the Board on behalf of the Council. It was stated that, since the Committee met, an Inspector from the Local Government Board offices had visited Torquay, and had an interview with the officials; but the result had not transpired, and the work was still going on.

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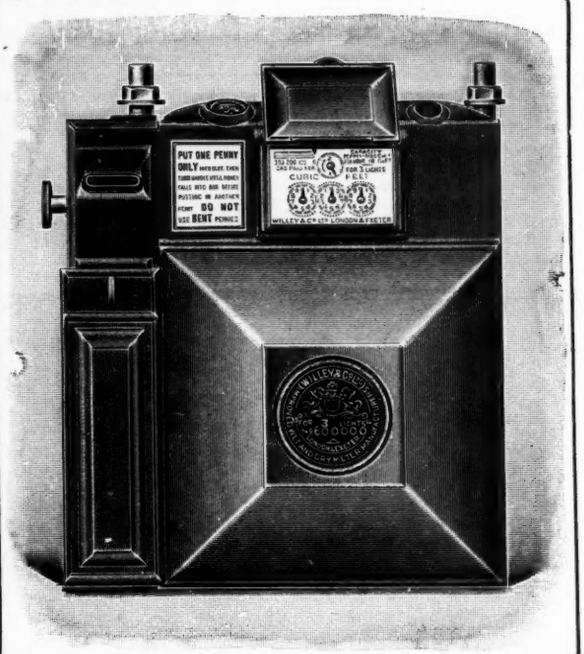

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Destructive Fires at Berlin Gas-Works.—According to the Paris "Journal" a series of mysterious outbreaks of fire has recently occurred in Berlin, a large quantity of goods of prime necessity being destroyed on each occasion. Within a week fires have taken place at a number of gas-works, destroying several hundred thousand tons of coal. The Lindenstrasse quarter of the capital had to be inundated to prevent the spread of fire, and property has suffered considerably in consequence.

Explosion at Weston-super-Mare Gas-Works.—On Friday evening, a Bristol paper states, a good deal of excitement was caused among residents at Weston-super-Mare by an explosion accompanied by a bright flash; it being thought that an air raid was being made on the town. The trouble, however, proved to be in connection with a small holder used for the water-gas plant at the Gas Company's old works. Damage was sustained by the roof of the purifier-house; but there was no case of personal injury.

Maryborough (Queensland) Gas Company, Limited.—The report of the Company for the past half year states that the profits, after making provision for bad and doubtful debts, repairs and renewals, depreciation, working expenses, wear and tear, and other charges, including the balance brought forward, amounted to £1240, from which the Directors recommended the payment of the usual dividend of 6 per cent. per annum, free of income-tax. This would absorb £990, and leave £250 to be carried forward.

Plymouth Water Profits.—A financial statement presented to the Plymouth Corporation Water Committee shows that for the year ended March 31 last the gross profit of the Plymouth undertaking was £25,302, and of the Devonport works £19,230. From the profit on the Plymouth undertaking there has to be deducted £9534 for dividends and interest, £2002 for income-tax, and £4911 for redemption of stock and mortgages—leaving a balance of £8849 as net profit to be carried to the borough fund. In the case of the Devonport works, £11,686 is required for interest, £3835 for redemption of loans, and £332 for income-tax—leaving £3382 as net profit, which it is proposed to carry to the reserve fund.

Bradford New Water-Works Stopped.—The Town Clerk (Mr. Frederick Stevens) has received a communication from the Local Government Board intimating, practically, that the works now proceeding in connection with the water undertaking of the Bradford Corporation must be stopped. An Inspector of the Board recently visited Bradford, for the purpose of inquiring into the City Council's contention that the completion of the duplication of the pipe-line from the Nidd Valley—the principal work involved—was essential to the industry and welfare of the city.

Scarborough Public Lighting Charge.—A curious position has, says the "Leeds Mercury," arisen with regard to the street lighting of Scarborough. Owing to the restriction of lighting, the quantity of gas taken by the Corporation from the Gas Company has, it has been reported to the Corporation, fallen below the minimum amount which entitles the Council to discount. As a matter of fact, had a considerable quantity more been used it would have meant a less cost to the Corporation than losing the discount will mean. The matter has been referred to the Chairman of the Lamps Sub-Committee (Mr. Fletcher) and the Chairman of the Finance Committee (Alderman Rowntree), with a view to seeing whether any arrangements can be come to with the Company.

APPLICATIONS FOR LETTERS PATENT.

12,508.—GALE, A. R., "Gas-turbines." Aug. 31.
12,595.—ANTROBUS, W., "Production of water and illuminating gas and bye-products." Sept. 2.
12,603.—ALEXANDER, J., "Gas-producers." Sept. 2.
12,608.—PROCKTER, F. M., and SWINDIN, N., "Treating gases with liquids." Sept. 2.
12,676.—MOUNTAIN, H., and WORSFOLD, J., "Gas cooking apparatus." Sept. 3.
12,695.—HALL, I., "Burning gas." Sept. 4.
12,714.—LEYSHON, A. D., "Stopcocks." Sept. 4.

GAS COMPANIES IN THE STOCK EXCHANGE.

The week just closed on the Stock Exchange was a quiet one, but anyhow it managed to compass a little more activity than its predecessor. The general tone, too, was decidedly firm. A cheery anticipation of appreciably improving conditions naturally engendered an indisposition to sell at existing prices; and the scarcity of stock consequent thereon had its influence in reducing business to very moderate proportions. A gratifying feature was the continued upward progress of Home Government issues; and War Loan quotations were carried up on the rising tide. Colonial issues were in good request, especially those redeemable at early dates, and the popularity of this class of security is very evident. A favourable factor was provided by the trade returns for August with their notable improvement in exports. Canadian securities advanced on a continuation of good reports in regard to harvest prospects. Home Rails made a further recovery from the persistent depression under which they had suffered. South Africans were in demand. Among the Miscellaneous group, there were several very strong lines. Conspicuous in this quarter were shipping, rubber, and oil, and those connected with armaments and warlike appliances. In the House there is some agitation in progress for a further reduction of minimum prices. To some extent this would be not unreasonable, but it is a measure needing mature consideration. Bank returns indicate that an increasing amount of gold is being withdrawn from internal circulation. It is a pity that the hands of the bankers are not strengthened by a Treasury order enabling them to resist unreasonable demands by their customers for gold. Business in the Gas Market was really quieter than ever; the aggregate of bargains recorded being only about a couple of dozen. If this be a sign that shareholders are sitting tight on their holdings, it is a good one. The Money Market was firm.

Bargains done for cash during the week were as follows: On Monday, Gas Light ordinary 78½, 79, ditto maximum 59⅞, ditto preference 72, 73, South Metropolitan 81. On Tuesday, Gas Light ordinary 78½, 79, 79½, ditto maximum 59⅜, 59½, 59⅞, ditto preference 72, 73, Primitiva 2$\frac{17}{32}$. On Wednesday, Oriental 100, 100⅜. On Thursday, British 37, Gas Light debenture 62. On Friday, Gas Light ordinary 78½, Primitiva 2⅛, ditto preference £3 10s. 6d., South Metropolitan 80. The Exchange was closed on Saturday.

The Bank rate is 5 per cent.—as fixed on Aug. 8, 1914.

LOWEST AND HIGHEST PRICES OF BARGAINS DONE FOR CASH IN THE WEEK ENDING SEPT. 11.

Issue.	Share.	When Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices. July 30.	Yield on Highest Closing Price.	Lowest and Highest Prices of Bargains.
£			p.c.		£ s. d.		
1,551,868	Stk.	April 8	3½	Alliance & Dublin Ord.	59—64	3 18 2	..
374,000	,,	July 10	4	Do. 4 p.c. Deb.	76—79	5 1 3	..
280,000	5	April 29	7½	Bombay, Ltd.	5⅞—6⅜	5 17 8	..
50,000	10	Feb. 26	16	Bournemouth Gas and Water — 10 p.c.	29—30	5 6 8	..
873,480	10		7	B 7 p.c.	15—15½	4 10 4	..
95,000	10	,,	6	Pref. 6 p.c.	13½—14	4 5 9	..
—	—	—	—	Deb.	..	—	..
380,000	Stk.	Feb. 26	14	Brentford Consolidated	261—266	5 5 3	..
330,000	,,	,,	11	Do. New	204—209	5 5 3	..
50,000	,,	,,	5	Do. 5 p.c. Pref.	109—111	4 10 1	..
206,250	,,	June 11	4	Do. 4 p.c. Deb.	91—93	4 6 0	..
217,380	Stk.	Feb. 26	11	Brighton & Hove Orig.	208—213	5 8 4	..
244,200	,,	,,	8	Do. A Ord. Stk.	154—159	5 0 8	..
630,000	20	Mar. 26	12½	British	44—45	5 11 1	37
120,000	Stk.	June 26	4	Do. 4 p.c. Deb. Stk.	88—90	4 8 11	..
245,771	Stk.	June 26	4	Buenos Ayres 4 p.c. Deb.	85—87	4 12 0	..
100,000	10	—	—	Cape Town & Dis., Ltd.	1¼—2¼	—	..
100,000	10	—	—	Do. 4½ p.c. Pref.	4—6	—	..
100,000	Stk.	June 26	4½	Do. 4½ p.c. Deb. Stk.	70—75	6 0 0	..
157,150	Stk.	Feb. 26	5	Chester 5 p.c. Ord.	108—110	4 10 11	..
1,513,280	Stk.	Feb. 12	5/9/4	Commercial 4 p.c. Stk.	106—108	5 1 2	..
560,000	,,	,,	5½	Do. 3½ p.c. do.	103—105	5 1 6	..
475,000	,,	June 11	3	Do. 3 p.c. Deb. Stk.	69½—71½	4 3 11	..
800 000	Stk.	,,	4	Continental Union, Ltd.	76—79	5 1 3	..
200 000	,,	,,	7	Do. 7 p.c. Pref.	115—118	5 18 8	..
—	—	—	—	Croydon B and C 7 p.c.	..	—	..
492,270	Stk.	—	6	Derby Con. Stk.	123—125	4 16 0	..
55,000	,,	—	4	Do. Deb. Stk.	102—104	3 16 11	..
1,002,180	10	July 29	10	European, Ltd.	17½—18	5 11 1	..
16,362,910	Stk.	Feb. 12	4/17/4	Gas Light and Coke — 4 p.c. Ord.	98—102	4 15 6	78½—79½
2,600,000	,,	,,	3½	3½ p.c. max.	76—79	4 8 7	59⅝—59⅞
4,062,235	,,	,,	4	4 p.c. Con. Pref.	96—99	4 0 10	72—73
4,674,850	,,	June 11	3	3 p.c. Con. Deb.	72½—74½	4 0 6	62
130,000	,,	,,	10	10 p.c. Bonds	..	—	..
258,740	Stk.	Mar. 12	5	Hastings & St. L. 3½ p.c.	87—89	5 12 4	..
70,000	10	April 29	11	Hongkong & China, Ltd.	16½—16⅝	6 11 4	..
—	—	—	—	Hornsey 7 p.c.	..	—	..
131,000	Stk.	Mar. 12	7½†	Ilford A and C	151—154	5 2 4	..
65,780	,,	,,	6½†	Do. B	115—118	5 8 0	..
65,500	,,	June 26	4	Do. 4 p.c. Deb.	92—94	4 5 1	..
4,940,000	Stk.	May 14	9	Imperial Continental	150—160	5 12 6	..
1,235,000	Stk.	Feb. 12	3½	Do. 3½ p.c. Deb. Red.	84—86	4 1 5	..
200,242	Stk.	Mar. 12	6½	Lea Bridge Ord. 5 p.c.	119—121	5 7 5	..
561,000	Stk.	Feb. 26	10	Liverpool 5 p.c. Ord. (A)	211—213	4 13 11	..
718,100	,,	,,	7	(B)	146—14	4 14 7	..
306,083	,,	June 26	4	Do. 4 p.c. Pr. Deb. Stk.	..	—	..

Issue.	Share.	When Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices. July 30.	Yield on Highest Closing Price.	Lowest and Highest Prices of Bargains.
£			p.c.		£ s. d.		
75,000	5	June 11	6	Malta & Mediterranean	4½—4⅝	6 9 9	..
250,000	100	April 1	4½	Met. of Melbourne — 4½ p.c. Deb.	99—101	4 9 1	..
541,920	20	May 28	4	Monte Video, Ltd.	11½—12	6 13 4	..
1,775,892	Stk.	July 29	4½	Newc'tle&G'tesh'd Con.	99¼—99½	4 10 6	..
529,705	Stk.	June 26	3½	Do. 3½ p.c. Deb.	83—83	4 4 10	..
55,940	10	Feb. 26	7/14/0	North Middlesex 7 p.c.	14—15	5 2 8	..
300,000	Stk.	May 14	8	Oriental, Ltd.	117—122	6 11 2	100—100¾
60,000	5	Mar. 26	10	Ottoman, Ltd.	7¼—7⅜	6 9 0	..
60,000	50	Feb. 26	12	Portsea, Island B	128—131	4 19 8	..
100,000	50		12	Do. C	118—121	4 19 2	..
52,000	50	,,	10	Do. D	..	—	..
249,980	5	April 29	8	Primitiva Ord.	5½—6	6 13 4	2½—2$\frac{17}{32}$
499,960	5	June 26	5	,, 5 p.c. Pref.	4⅝—5	5 0 0	3/10/6
521,600	100	June 2	4	,, 4 p.c. Deb.	91—93	4 6 0	..
—	—	—	—	,, ,, 1911	..	—	..
346,198	Stk.	June 26	4	River Plate 4 p.c. Deb.	85—87	4 12 0	..
150,000	10	May 14	6	San Paulo — 6 p.c. Pref.	10½—11	5 9 1	..
125,000	50	July 1	5	5 p.c. Deb.	47—49	5 2 0	..
135,000	Stk.	Mar. 12	10	Sheffield A	223—224	4 9 3	..
209,984	,,	,,	10	Do. B	222—224	4 9 3	..
523,500	,,	,,	10	Do. C	220—222	4 10 1	..
90,000	10	May 28	9	South African	10½—11½	7 16 6	..
6,429,895	Stk.	Feb. 12	5/4/0	South Met., 4 p.c. Ord.	111—113	4 16 8	80—81
1,895,445	,,	July 10	3	Do. 3 p.c. Deb.	72½—74½	4 0 6	..
209,820	Stk.	Feb. 26	8½	South Shields Con. Stk.	157—159	5 6 11	..
952,795	Stk.	Feb. 26	6	S'th Suburb'n Ord. 5 p.c.	114—116	5 8 6	..
60,000	,,	,,	5	Do. 5 p.c. Pref.	110—112	4 9 3	..
—	—	—	—	Do. West Kent.	..	—	..
137,058	,,	June 26	5	Do. 5 p.c. Deb. Stk.	116—118	4 4 9	..
629,740	Stk.	May 14	5	Southampton Ord.	99—102	4 18 0	..
120,000	Stk.	Feb. 12	7½†	Tottenham District — A 5 p.c.	135—138	5 8 8	..
742,275	,,	,,	6†	B 3½ p.c.	115—117	5 2 7	..
181,255	,,	June 26	4	4 p.c. Deb.	87—89	4 9 11	..
182,380	10	Dec. 30	5	Tuscan, Ltd.	5—6	8 6 8	..
149,900	10	July 1	5	Do. 5 p.c. Deb. Red.	93—95	5 5 3	..
236,476	Stk.	Mar. 12	5	Tynemouth, 5 p.c. max.	108½—109½	4 11 4	..
				Wandsworth, Wimbledon, and Epsom—			
80,000	Stk.	Feb. 26	8⅜	Wandsworth A 5 p.c.	151—156	5 7 4	..
255,636	,,	,,	6⅞	,, B 3½ p.c.	129—134	5 2 7	..
108,075	,,	,,	5/17/8	,, C 3½ p.c.	110—115	5 2 0	..
852,000	,,	,,	6½	Wimbledon 5 p.c.	117—122	5 0 5	..
98,000	,,	,,	6⅝	Epsom 5 p.c.	121—126	5 5 2	..
88,416	,,	June 26	3	3 p.c. Deb. Stk.	66—69	4 6 11	..

The office of H.M. Trade Commissioner for South Africa reports that tenders are invited by the Johannesburg Municipal Council, up to noon on the 9th prox., for the supply and erection, at the Council's generating-station, of a water-purifying plant with a capacity of 75,000 gallons per 24 hours.

The International Time Recording Company, Limited, are removing to larger and more convenient premises at No. 57, City Road, Finsbury, E.C., where they hope to be better able to look after the increasing demand for their Dey, Bundy, Rochester, and International automatic time-recording machines.

The Pastor of a Llandudno Congregational Church, while a guest in a house at Croydon, was, after complaining of feeling unwell, found dead on the floor of the lavatory, with the gas turned full on, and unlit. It was suggested that deceased, who was in a very weak condition, had turned on the gas and fainted, being then overcome. The Jury returned a verdict of "Accidental death."

It is reported from the United States that the works at Chester, Conn., where aniline dyes are being made by a secret process, are to be operated by the Middlesex Chemical Company, recently organized with $250,000 of preferred stock and $250,000 of common stock. The Company recently turned out the first pure carbolic acid crystals ever obtained in America, which is of "tremendous importance to the dye and acid trade."

The Rochester City Council have agreed to an arrangement with the Gas Company whereby the latter are to include in their quarterly bills a sum of £43 17s. 6d. in respect of the cleaning and repairing of the lanterns of the street-lamps which are not lighted.

A successful flower and vegetable show was recently held in the East Greenwich Gas-Works Institute; the opening ceremony being performed by Mr. A. F. Browne, the Acting Engineer at the station. There was an increased number of entries on the present occasion. The late Secretary (Mr. R. Stanton), now in France on active service, wrote wishing the show all possible success.

The Government of Newfoundland have forwarded to the Board of Trade for confirmation a contract made last April between them and the Newfoundland Products Corporation, Limited. It is proposed, *inter alia*, that certain articles shall be admitted, free of duty, either into the Colony or into Labrador: (1) All constructional material and machinery for the Company's mills, factories, and works, for the purpose of the manufacture of . . . fertilizers, carbide of calcium, and their bye-products, and for the purpose of such manufactures, both for original installation and further extension, but not in substitution for old. (2) All bags and packages for distributing the Company's products, as required by the Company for the purpose of the manufacture of fertilizers, &c. (3) All coal required by the Company for use in Labrador for the purposes mentioned.

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

ASSISTANT MANAGER. No. 6092.
WORKING MANAGER. Isaac Carr and Sons, Widnes.
CHIEF DRAUGHTSMAN. Liverpool Gas Company. Applications by Sept. 21.
DRAUGHTSMAN. No. 6089.
FOREMAN. No. 6091.
RETORT-HOUSE FOREMAN. Leeds Gas Department.
WORKS FITTER. Darlington Gas-Works.

Appointments Wanted.

CLERK. No. 6093.
REPRESENTATIVE. Charrière, Paris.

Plant, &c. (Second-Hand) for Sale.

KEITH-BLACKMAN COMPRESSOR. No. 6094.
GAS FITTINGS, &c. R. J. Curtis, Union Offices, Birmingham.

Plant, &c. (Second-Hand) Wanted.

GASHOLDERS. M. F., c/o Messrs. J. G. King and Son.

Meetings.

BRITISH GASLIGHT COMPANY. 11, George Yard, Lombard Street, E.C. Sept. 29. Twelve o'clock.

Sales of Stocks and Shares.

BROADSTAIRS GAS COMPANY. London Mart. Sept. 21.

TENDERS FOR

Coal.

SIDMOUTH GAS DEPARTMENT. Tenders by Sept. 24.
TRALEE GAS DEPARTMENT.

Fire-Clay Goods.

LLANDUDNO URBAN DISTRICT COUNCIL. Tenders by Oct. 1.

Retorts (Resetting).

TODMORDEN GAS DEPARTMENT.

Tar.

CLONMEL CORPORATION GAS COMMITTEE. Tenders by Sept. 30.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office NOT LATER than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

Wanted, For Sale, and Tender Advertisements, Six Lines and under, 3s.; each additional Line, 6d.

TERMS OF SUBSCRIPTION to the "JOURNAL."

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